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NBC REPORT

U.S. Army Nuclear and Chemical Agency

Spring - Summer 1999

HEMP Survivability

Low-Level Radiation (LLR) In Military Operations

Battlefield Nuclear Targeting Optimized (BNTO) Software

Non-Ideal Air Blast

Survivability of Army Personnel and Materiel

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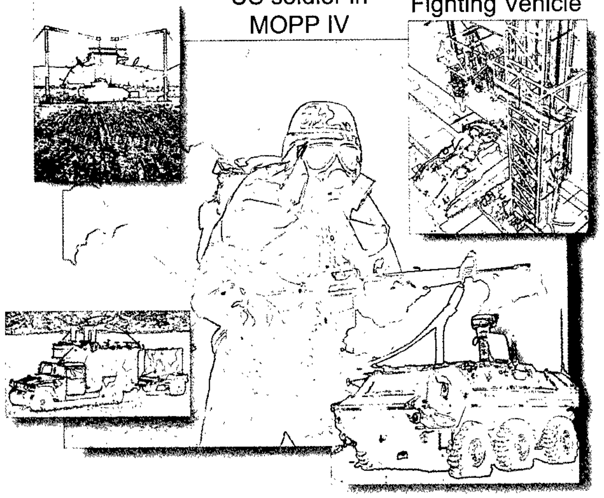
HEMP testing of a Bradley Fighting Vehicle

US soldier in MOPP IV

Radiation shielding test of a Bradley Fighting Vehicle



Biological Integrated Detection System (BIDS)

FOX, NBC reconnaissance vehicle

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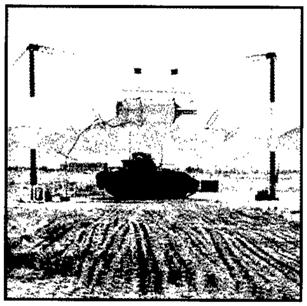

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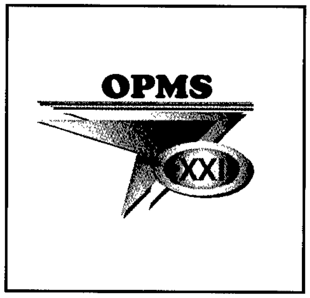

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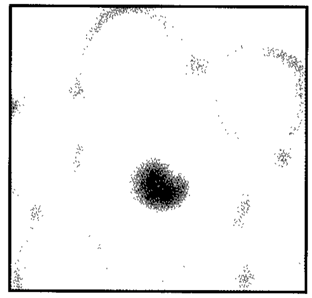

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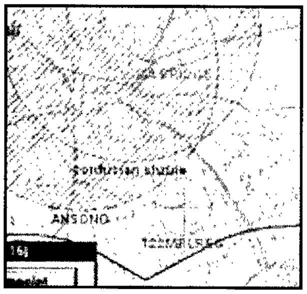

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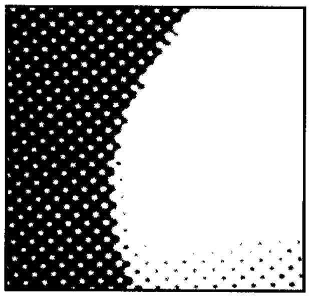

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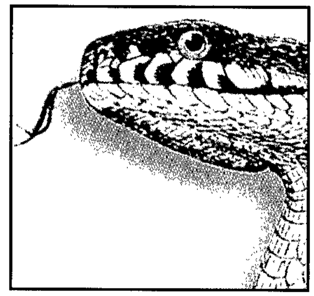

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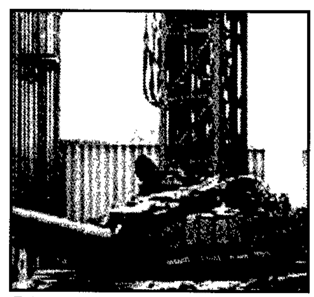

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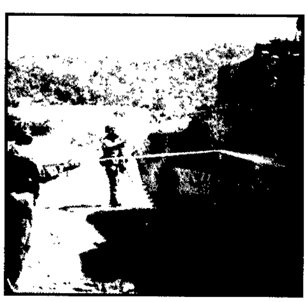

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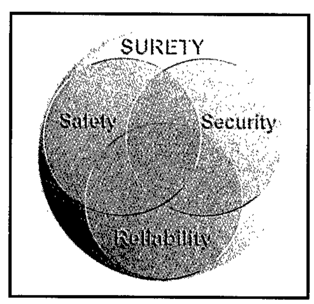

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Surety Update

FROM THE DIRECTOR

HEMP Survivability: Exposing the Myths

DR. CHARLES N. DAVIDSON
DIRECTOR
U. S. ARMY NUCLEAR AND CHEMICAL AGENCY

A substantial portion of this issue of NBC Report is devoted to efforts that enhance survivability of Force XXI assets in NBC environments. On page 6, Captain Marc Umeno addresses low-level radiation hazards that personnel could encounter in peace support operations. Major Brent Bredehoft highlights specific examples of achieving equipment survivability to high-altitude electromagnetic pulse (HEMP) beginning on page 16, and also reports on recent results of testing commercial off-the-shelf (COTS) computers to HEMP. Mr. Warren Dixon of TRADOC Headquarters on page 20 takes us through the thought processes necessary to establish meaningful requirement statements for NBC contamination survivability in the ORD. And Mr. Steve English of SBCCOM lays out guidelines and points of contact on page 25 that will help achieve those requirements.

As we address survivability on a day-to-day basis, we too often encounter statements to the effect that NBC survivability for equipment is impractical, unaffordable, or even unnecessary. Frequently, these statements are offered sincerely in the belief they are true. We have come to refer to a number of these statements as "survivability myths." Let's look at the most common of these myths, in the context of one of the more critical areas of survivability—the HEMP associated with a nuclear detonation. (Similar arguments apply to other aspects of NBC survivability.)

MYTH: **The need for nuclear survivability is an obsolete carryover from Cold War days.** Secretary of Defense Cohen has addressed this most succinctly in the preface of his November 1997 report, Proliferation: Threat and Response. He states that "...the United States faces a heightened prospect that regional aggressors, third-rate armies, terrorist cells,and even religious cults will wield disproportionate power by using, or even threatening to use, NBC weapons against our troops in the field and our people at home....American military superiority actually *increases* the threat of NBC attack against us by creating incentives for adversaries to challenge us asymmetrically.... Defense planners must assume that use of chemical and biological weapons is a likely condition of future warfare and that these and nuclear weapons are likely to be used early in the conflict to disrupt U.S. operations and logistics." The point on asymmetric challenges is key. What better way for a third world proliferant to level the playing field than to burst one crude nuclear weapon at high altitude, creating widespread damage to unhardened, sophisticated system electronics. Secretary Cohen's statement dispels the notion of nuclear survivability being an obsolete carryover.

MYTH: **The Army leadership doesn't really support HEMP survivability.** Actually, the opposite is true. The Army leadership has repeatedly underscored the criticality of HEMP survivability, both before and after Secretary Cohen's report. For example, Army Regulation 70-75, dated January 1995, specifically requires mission essential items to be HEMP-survivable. And as recently as 25 September 1997, the current Army Deputy Chief of Staff for Operations and Plans, LTG Burnette, stated in a policy memo that "...the nuclear, biological and chemical survivability of tactical systems continues to be a critical element in Army plans and needs your continued attention....To maintain our current dominance in the face of an increasing WMD threat, we must continue to build NBC survivability into our tactical systems....Mission essential equipment hardened against WMD effects remains a critical element in support of the Army's mission of deterrence and has the support of the senior leadership of the Army....As a minimum, high-altitude electromagnetic (HEMP) survivability is required for mission critical equipment to preclude theater-wide loss."

MYTH: **Only the Army cares about HEMP survivability. It'll put us at a real disadvantage in competing for sales with other Services and other countries.** Not so. All Services are bound by the post-Cold War, DoD-approved MIL-STD 2169B on HEMP criteria when acquiring mission-critical strategic and tactical systems. Further, this same MIL-STD is formally embodied

within ratified international agreements on nuclear survivability criteria, specifically ABCA QSTAG 244 and NATO STANAG 4145.

MYTH: HEMP survivability is not achievable. Again, not so. The Services have been successfully developing and fielding HEMP-survivable systems for over twenty years. Protection is the preferred method of achieving survivability. HEMP protection is essentially a system design problem. Proper circuit design early on in development costs virtually nothing in weight. Attention to detail in electronics case design, use of fiber optics, and design of the transporting signal shelter can eliminate unnecessary apertures and unintended antennas and provide necessary electromagnetic shielding. Terminal protective devices similar to those used to protect computers from power surges from near-strike lightning are inexpensive. In addition to protection, field mitigation techniques in laying and coiling connecting power cables can reduce unintended antennas. And good field discipline can ensure HEMP protection is not degraded during maintenance or modification of fielded equipment.

MYTH: Just field mitigation techniques will do the trick. Unfortunately, field mitigation by itself won't hack it. Cable discipline can reduce current pickup, but it can't eliminate it since the system itself can act as an unintended antenna. Both the system components and connections are important. Even the "tried and true" field mitigation techniques of unplugging or powering down equipment when not in use, and disconnecting antennas in anticipation of a HEMP event, are often neither tried nor true. In addition to the fact that enemy HEMP events will not usually be known in advance, internal circuitry can attract substantial HEMP-generated currents even with power off (see Brent Bredehoft's article on survivability in this issue). Further, some electronics must remain powered up all the time in order to do their job. And frequent turning off and on can significantly reduce mean times between failure for some C4I systems. Good system design using electromagnetic shielding and terminal protective devices is necessary.

MYTH: Stocking spares nearby will do the trick. Wrong again. "Nearby" is the key word here. To be tactically useful, the spares would indeed have to be nearby and quickly available. But since the damaging HEMP electric fields from a single HEMP event extend over thousands of square kilometers (in some cases this could be theater-wide), nearby spares could be damaged as well, even if we could afford them. With today's most likely threat being a relatively few nuclear weapons, spare items of equipment may compensate for not hardening to air blast, thermal radiation, and nuclear radiation, but they will not compensate for HEMP vulnerabilities.

MYTH: HEMP hardening will cost an arm and a leg. Validated cost data for achieving HEMP survivability in already fielded systems shows otherwise. In thirteen Army systems for which RDTE costs were carefully tracked for achieving survivability to all nuclear effects (not just HEMP), the most expensive was SINCGARS at 1.4% of total RDTE costs. The remaining twelve, which include the M1A2 Abrams tank, the M2A3 Bradley IFV, MLRS, FISTV, and ATACMS, all came in well under 1.0%. Where similar data exist for production and maintenance costs, again all were at 1.0% or less, with the exception of production costs on the Firefinder PIP which were at 1.8%. The cost myth is perhaps one of the most pervasive, but the facts simply do not support it.

MYTH: COTS and NDI items are excused from meeting, or even having, survivability requirements. Survivability requirements are laid down in the ORD. Using COTS and NDI equipment is an acquisition strategy, not a modification of the requirement. To again quote the Army DCSOPS, "...the use of commercial off-the-shelf (COTS) and non-developmental items (NDI) do not negate the requirement to be HEMP and NBC survivable." As in other acquisition strategies, use of COTS/NDI equipment requires skilled and informed selection of components and careful design. In many cases, the proper choice of COTS technology may provide a substantial measure of inherent hardness. There are a number of high visibility Army systems with major COTS/NDI components, already or soon-to-be fielded, that have satisfactorily passed HEMP survivability testing.

MYTH: If a HEMP event never occurs, money spent for HEMP survivability is wasted. This is roughly akin to saying that money spent on armoring a tank is wasted if no one fires at it, or that stocking and wearing protective overgarments in theater during the Gulf War was wasted because chemicals weren't employed against us. When we look at the widespread nature of the HEMP threat, the consequences are extremely high even if the likelihood is less than high. As a senior Army general officer said recently, "...given the consequences of not hardening to HEMP, it's relatively cheap insurance to do so." Consider also the bonus effects of HEMP hardening. Protection against HEMP will enhance protection against near-strike lightning, electromagnetic interference,high-powered microwaves, and radio frequency or non-nuclear EMP weapons. In fact, the smart way ahead is to design all types of electromagnetic protection into the system at the same time in a unified manner. Keep an eye out for our article on this in the next issue of NBC Report.

Bottom line: HEMP survivability is necessary, achievable, affordable, and supported by the Army leadership. We need to forget the myths and get on with it.

OPMS XXI and the Functional Area 52 Officer

LTC Robert R. Beimler, FA
Functional Area 52 Proponent Manager, USANCA

With the formal implementation of OPMS XXI effective 1 October 1998, the focus of the officer corps will turn to transition issues relative to the personnel management system that will carry our Army into the 21st century. Through a variety of media, including the "Blue Book," What is OPMS XXI?, and other frequently asked questions, chain teaching, and articles in Army Times, general information on OPMS XXI implementation seems to be making its way to officers. Rather than provide an additional rendition of these same topics, this article will focus on OPMS XXI as it relates directly to Functional Area 52 (FA52), Nuclear Research and Operations.

Recoding

One of the first and still ongoing processes under OPMS XXI is the effort to recode Army authorization documents to reflect changes in available functional areas and to identify branch and functional area positions that require redefined skills, knowledge and attributes. As it applies to FA52, this process focuses primarily on recoding Functional Area 54 (Plans, Operations and Training) billets in existing organizations with nuclear missions. The Army established many of these FA54 "nuclear operational" billets in the early 1990s, following the elimination of Army tactical nuclear weapons. As a result of this initial recoding, FA52 supports OPMS XXI with 113 field-grade authorizations (15 – COL, 42 – LTC, 56 – MAJ), up from the 78 authorizations as of October 1997.

OPMS XXI Career Fields
Operations - 65%
Operations Support - 16%
Institutional Support - 11%
Information Operations - 8%

Career Field Designation (CFD)

CFD is the process by which the Army distributes officers among the four OPMS XXI Career Fields (Operations, Operations Support, Information Operations, and Institutional Support) to meet personnel manning requirements for each branch and functional area. FA52 is in the Institutional Support (IS) Career Field, along with FA43 - Human Resource Management; FA45 – Comptroller; FA47 – USMA Permanent Instructor; FA49 – Operations Research/Systems Analyst; FA50 – Strategic Force Development; and FA59 – Strategic Plans and Policy. The Army will conduct initial CFD boards in FY99 for year groups (YG) 80, 86, and 89. For the transition lieutenant colonel YGs (80-85), the current target is to designate eight officers from each YG into IS/52. For the transition major YGs (86-88), the current target is to designate ten officers from each YG into IS/52. In the "steady state" model, beginning with YG 89, the plan is to designate 11 promotable captains into IS/52 each year in conjunction with the release of their promotion lists. "CFD Straw Polls" conducted by the FA52 Proponent and PERSCOM indicate demand for CFD into IS/52 will be greater than available IS/52 target designations. An officer desiring to career field designate into IS/52 will likely have to list IS/52 as his/her #1 choice on the CFD preference form. Results of initial CFD boards and lessons learned will be published when available. For additional information on the CFD process and "straw poll" data, visit the OPMS XXI Home Page at http://www.army.mil/opms/.

Career Field Designation By YG	
Mar 99	YG 80, YG 86
Jun 99	YG 89
Oct 99	YG 81, YG 87
FY 00	YG 90
FY 01	YG 82, YG 83, YG 88, YG 91
FY 02	YG 84, YG 85, YG 92

Functional Area Designation (FAD)

Identifying FAD preference will continue for captains in their fifth year of service, with minor modifications, under OPMS XXI. The Army will modify the distribution of officers to each functional area to correspond with structure changes under OPMS XXI. The Army will likely designate 30-35 captains into FA52 each year. These officers will continue to be assigned against FA52 captain authorizations and will continue to have an opportunity to attend Advanced Civil Schooling following basic branch qualification.

Advanced Civil Schooling [ACS]

Neither the process nor the requirements for ACS have changed with implementation of OPMS XXI. FA52 officers will continue to attend ACS at approximately the same rate and in the same fields as in previous years. The major impact of OPMS XXI on ACS is the opportunity for officers to attend following CFD. Because a career field designated IS/52 major does not have to be branch qualified in his/her basic branch for promotion to LTC, the officer now will be able to apply for ACS. Attendance at ACS and a follow on FA52 utilization tour provide sufficient experience to qualify an officer for promotion to LTC. The new opportunity for career field designated IS/52 majors to attend ACS does not preclude FA52 branch qualified captains from attending ACS. However, ACS of FA52 branch qualified captains does NOT guarantee selection for CFD into IS/52. An advanced educational degree is only one of many factors considered by the CFD Board.

FA52 Academic Disciplines
Nuclear Engineering
Engineering Physics
Applied Physics
Applied Health Physics
National Security Affairs (Nuclear)

Nuclear Research and Operations Officer Course [NROOC]

Under OPMS XXI and DA PAM 600-3, NROOC is the functional area qualifying course for FA52. Beginning in FY02 for YG86 officers, the Army will require completion of NROOC before an officer can be promoted to lieutenant colonel in IS/52. As a functional area qualifying course, the Army will fund NROOC under the Military Training Special Allotment (MTSA) beginning in FY01. In the interim, current or gaining organizations will continue to fund officer attendance at NROOC, the process in place since elimination of the Army's Military Training Open Allotment.

Promotions

One of the biggest changes under OPMS XXI is promotion criteria where the Army will begin to promote within a particular career field. First, the Army will promote to meet existing FA52 requirements for the appropriate grade. This means that the "best qualified" IS/52 officers will be selected to fill FA52 requirements. After sufficient IS/52 officers are promoted to meet requirements, the remaining IS/52 officers will compete with the remaining officers from other functional areas in the Institutional Support Career Field (ISCF) for promotions required to bring the ISCF promotion rate to the DOPMA desired rate. IS/52 officers will NOT compete against officers in other career fields for promotions to the grades of LTC and COL.

Assignments

Once CFD is complete, the Army will assign IS/52 officers to FA52 billets, branch immaterial billets, or the student account for military professional development courses or ACS. Because the FA52 grade structure is very close to the optimal personnel management structure, IS/52 officers will seldom participate in branch immaterial assignments. IS/52 officers should anticipate consecutive, developmental FA52 assignments, with only attendance at required professional development courses between assignments. Captains, prior to CFD, will serve in FA52 billets as required, but the opportunities are limited.

For additional information on OPMS XXI impact on FA 52, contact your assignments officer at PERSCOM or the FA52 Proponent Manager at DSN 656-7866, commercial (703) 806-7866 or email beimler@usanca-smtp.army.mil

Low-Level Radiation [LLR] in Military Operations

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Since the end of the Persian Gulf Conflict, reports of the controversial "Gulf War Illness" have made the military increasingly aware that one of its mission goals for all operations should be to preserve the long-term health of its personnel. USANCA has been responsible for much of the low-level radiation (LLR) portion with its involvement in NATO and within the Department of Defense (DoD).

Current U.S. operational nuclear defense doctrine addresses issues resulting from large nuclear weapons exchanges between Cold War superpowers. Radiation protection guidance was designed to prevent short-term performance degradation from acute radiation injury. Compared with nuclear Armageddon, prevention of long-term diseases was an insignificant issue. The intensity spectrum of today's military operations, however, ranges from peacekeeping and humanitarian assistance to major regional conflicts. As the U.S. military frequently deploys in support of lower intensity operations, protecting the health of our personnel becomes a mission priority. There is no current DoD policy or doctrine that addresses radiation risk management during these "small-scale contingency" operations.

Current Situation

Today's radiation threats are less severe in their military impact than an all-out exchange of nuclear weapons, but myriad radiation sources are more likely to appear during military operations, presenting serious hazards to personnel. A Chernobyl-type nuclear reactor accident might occur during deployments, which can generate a major, large-area radiation hazard. A radiation dispersal device spreads radioactive materials over an area using conventional explosives without resorting to a nuclear fission detonation. An improvised nuclear device generates a low-yield nuclear fission detonation, using technology similar to that used against Hiroshima and Nagasaki. Industrial and medical sources, radioactive waste, and nuclear reactor fuels are other possible radiation hazards in today's military operations. Depleted Uranium (DU) and other U.S. radioactive commodities are also present during military operations, but present a lesser health threat.

Current operational radiation exposure guidance for commanders accounts for the performance-degrading effects from acute injuries due to high doses of radiation. This guidance prevents units from incurring losses in operational strength from radiation exposure. It ignores long-term health effects from radiation exposure, such as cancer. Federal regulations account for long-term health effects from radiation exposure and apply to U.S. military personnel during peacetime, when the personnel are performing routine occupational tasks. These regulations do not apply to U.S. military personnel during military operations. Clearly, there is a need for guidance that takes into account both minimizing long-term health effects and maximizing operational flexibility.

NATO Working Group 2

NATO Working Group 2 (WG/2), LLR in Military Operations, was created in 1995 by Land Group 7 (LG/7) to address the LLR exposure guidance shortfall, produce LLR equipment standards, and provide any other related procedures and standards. WG/2 recognized that LLR in military operations was both an operational problem and a medical problem. Consequently, the group consists of NATO and Partnership for Peace (PfP) nations who provide military and civilian experts in nuclear physics/engineering, health physics, medicine, radiobiology, NBC defense, and field operations. USANCA's Director is the head of the U.S. delegation to WG/2.

Combining standards from multiple nations' regulations and accepted international health physics standards, WG/2 produced a recommended table (Table 1) of dose ranges for operational exposure guidance which maximizes operational flexibility and states the risks associated with certain dose ranges as operational exposure guidance. The guidance subdivided the radiation exposure state (RES) R-1 defined in NATO Standardization Agreement (STANAG) 2083, which ranged from 0-70 centigray (cGy). STANAG 2083 outlined commanders' operational exposure guidance for nuclear war. The scientific basis of the new guidance is the linear, no-threshold theory (LNT), which says that all doses of radiation, no matter how small, increase your risk of cancer. The LNT also says that the risk increases linearly with dose, so that four times a certain dose will make you four times as likely to get cancer. The table and accompanying procedural guidance was translated by the Supreme Headquarters Allied Powers Europe (SHAPE) NBC Staff Officer into an Allied Command Europe (ACE) directive, AD 80-63, ACE Policy for Defensive Measures against Low-Level Radiological Hazards during Military Operations.

Other WG/2 products include: LLR equipment standards (e.g., dosimeter and readers, dose-rate meters, spectroscopy, airborne survey); op-

erational decontamination tables and guidance; methods for field internal dose estimation; and LLR hazard prediction warning and reporting inputs. USANCA has been a major contributor to all of these efforts.

The main task remaining for WG/2 is to develop procedures for sampling and identifying radiological agents for operational and forensic tasks. Other possible efforts include retrograde/redeployment contamination standards for transport of equipment, technical and procedural "rules of thumb" for LLR scenarios, and LLR environmental issues.

Exercises

USANCA has sponsored or participated in four exercises conducted by the Concepts Analysis Agency to identify and examine U.S. Army and DoD requirements for operations in a LLR environment. GROUNDFIRE 95 and GROUNDSHINE 96 were tabletop exercises conducted in the U.S. to examine interoperability, equipment, logistics, and medical aspects of LLR on military operations. FEMTO 98 and ATOMIUM 98 were similar exercises conducted as NATO-PfP tabletop exercises dealing with medical LLR issues at NATO headquarters.

Other Efforts

USANCA is also involved in the NATO NBC Defense Working Group of the Military Agency for Standardization. This group is producing STANAG 2473, which will provide LLR exposure guidance and procedures, and will eventually supersede AD 80-63. USANCA is also the U.S. representative to the American-British- Canadian-Australian (Quadripartite) RADIAC Information Exchange Group, a subordinate to the NBC Defense Quadripartite Working Group.

DoD has undertaken many other LLR efforts. The U.S. Army Office of the Surgeon General leads the U.S. delegation to the NATO NBC Medical Working Group and has sponsored FEMTO 98. The NBC Medical Working Group is producing STANAG 2474 on dose recording standards. The U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) has undertaken a number of LLR-related projects, including producing tactics, techniques and procedures for using RADIAC instruments; developing methods for LLR risk assessment; and determining LLR tasks for the Theater Army Medical Laboratory unit. The Human Survivability and Human Response Programs of the Defense Threat Reduction Agency (DTRA) support LLR programs such as the Air Force's "fly-away" dosimetry capability; the U.S. Army Soldier and Biological Chemical Command's LLR airborne survey system; and the Armed Forces Radiobiology Research Institute's (AFRRI) LLR research and development programs.

Conclusion

Many LLR issues remain unresolved. DoD doctrine and policy do not address LLR in military operations. STANAGs 2473 and 2474 are being developed, but are not ready at this time. Much of our RADIAC equipment was designed and developed to measure high levels of radiation, as were the tactics, techniques and procedures to use that equipment. Some existing equipment is capable of detecting LLR, but is not calibrated to do so. Radiation hazard awareness training needs to be undertaken. As these efforts progress and the remaining problems are addressed, USANCA will continue to be a proponent for LLR issues in the U.S. Army and throughout DoD.

Table 1. LLR Operational Exposure Guidance for Military Operations

Total Cumulative Dose (See Notes 1 and 2)	RES Category	Recommended Actions
0.005 to 0.05 cGy	0	None
0.05 to 0.5 cGy	1A	Record Individual Dose Readings; Initiate Periodic Monitoring
0.5 to 5 cGy	1B	Record Individual Dose Readings; Continue Monitoring; Initiate Rad Survey; Prioritize Tasks; Establish Dose Control Measures As Part of Operations
5 to 10 cGy	1C	Record Individual Dose Readings; Continue Monitoring; Update Survey; Continue Dose Control Measures; Execute Priority Tasks Only (See note 3)
10 to 25 Cgy	1D	Record Individual Dose Readings; Continue Monitoring; Update Survey; Continue Dose Control Measures; Execute Critical Tasks Only (See note 4)
25 to 70 cGy	1E	Record Individual Dose Readings; Continue Monitoring; Update Survey; Continue Dose Control Measures; Execute Critical Tasks Only (See note 4)

Notes:

1. The use of the measurement millisieverts (mSv) is preferred. However, the military normally has only the capability to measure centigray (cGy). As long as the ability to obtain measurements in mSv is not possible, NATO will use cGy. For whole-body gamma irradiation, 1cGy = 10 mSv.
2. All doses should be kept as low as reasonably achievable (ALARA). This reduces individual soldier risk and retains maximum flexibility for future employment of exposed soldiers.
3. Examples of priority tasks are those missions to avert danger to persons or to prevent damage from spreading.
4. Examples of critical tasks are those missions to save lives.
5. Higher radiation dose rates produce proportionally more health risks than the same total dose given over a longer period.

Battlefield Nuclear Targeting Optimized (BNTO) Software

Dr. Muhammad Owais *(DTRA)*,
Mr. Tom Stephens *(SAIC)*, **LTC Randle Eric Scott, FA** *(USANCA)*

The warfighter's nuclear targeting toolbox just got bigger and more efficient. The Defense Threat Reduction Agency (DTRA) has released the Battlefield Nuclear Targeting Optimized (BNTO) software for field use. BNTO software assists nuclear targeteers in theater nuclear targeting analyses and aimpoint planning. BNTO automates the nuclear targeting and analysis methodology contained in the Secret Joint Pub 3-12.2 "Nuclear Weapons Employment Effects Data (U)." Dr. Dave Bash's article, "Joint Pub 3-12.2 Nuclear Weapons Employment Effects Data," in the Spring - Summer 1998 NBC Report gives an excellent overview of the publication.

BNTO is a Windows PC-based program requiring at least four megabytes of memory on Intel 80486 and Pentium-based PCs, and at least 3.5 Mb of free hard drive disk space for successful installation. It is the latest in a series of battlefield targeting programs sponsored and developed under DTRA contracts. BNTO updates and supersedes the Defense Nuclear Agency's FM-101 Targeting Aid, a PC-DOS program released in 1989. Science Applications International Corporation (SAIC) developed and optimized the BNTO software.

Ideally suited for theater nuclear targeting, BNTO uses specific weapon yields against standardized military personnel and equipment target sets. It makes use of all three prompt effects of nuclear detonation (blast, thermal radiation, and nuclear radiation) because, for many yields and targets, blast is not the governing effect. This is particularly important when dealing with personnel safety and preclusion of collateral damage, critical warfighter concerns. BNTO complements strategic nuclear targeting methodologies used by USSTRATCOM.

By now you are probably asking: who uses BNTO, how does it work, and where do you obtain appropriate training on its use?

Who Uses BNTO?

BNTO supports the same community Joint Pub 3-12.2 serves. Joint Pub 3-12.1, "Doctrine for Joint Theater Nuclear Operations," mandates the use of Joint Pub 3-12.2 by theater nuclear planners and target analysts. This includes planners from the Joint Staff, USSTRATCOM, Unified Commands, Army components of Joint Forces (ARFOR) or Joint Force Land Component Commanders (JFLCC), Echelons above Corps, and Corps Fire Support Elements. BNTO is also the principal automated nuclear target analysis tool used by USANCA's Nuclear Employment Augmentation Teams (NEAT).

How Does BNTO Work?

BNTO allocates nuclear weapons against multiple targets depicted on a digital "raster" map background (see Figure 1, page 9). BNTO enables the theater nuclear planner/targeteer to generate automatically sets of optimized aimpoint solutions for a battlefield situation. BNTO assigns a nuclear weapon to each aimpoint, and then generates and compares solution sets, assigning a relative figure of merit. Each solution set contains the minimum number of aimpoints necessary to meet the specified damage criteria for all targets, while not violating exclusion areas or commander's guidance.

BNTO is really a series of inputs and outputs. The inputs mirror those required by the manual targeting process. The inputs include:

- **target elements** - circular areas to destroy, representing target types defined in Joint Pub 3-12.2.
- **collateral damage avoidance elements** - circular exclusion areas containing civilian personnel and/or materiel to be protected from the effects of friendly nuclear weapons.
- **obstacle preclusion vulnerability elements** - circular exclusion areas containing installations or materiel to be protected, such as bridges or forests. The intent is to avoid inadvertent creation of obstacles to friendly movements.
- **forward-line-of-own-troops (FLOT)** - an exclusion element formed from connected line-segments identifying the primary division between friendly and enemy forces.
- **personnel safety elements** - circular exclusion areas containing friendly personnel masses.
- **aimpoints** - for a specific nuclear weapon from the stockpile (including specific heights of burst (HOB) and desired ground zeroes (DGZ)).

BNTO reflects these inputs as schematics on a map. BNTO performs the coverage calculations using the above elements, within the constraints of personnel safety and damage preclusion requirements. Results for each weapon system (see Figure 2) are summarized in tabulated reports (outputs) that present:

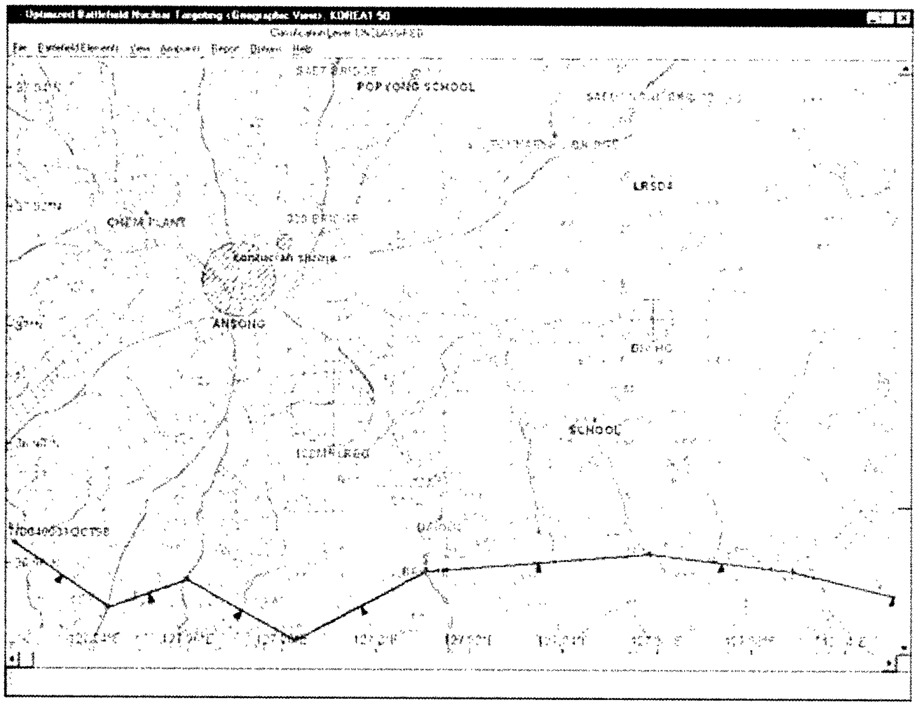


Figure 1. Example of a "nuclear case" on a raster map background. Built in the case are the FLOT, exclusion areas, targets, and nuclear weapons available.

■ **target coverage** - average percentage of target area that receives required degree of damage.

■ **target radii of damage (RD)** - distance from DGZ where there is 50% probability of achieving required damage.

■ **target maximum displacements (DMAX)** - largest offset from target center to DGZ that achieves a coverage greater than, or equal to, required coverage.

■ **collateral damage distances (CDD)** - separating a DGZ from collateral damage avoidance elements, to ensure that a specific incidence of injuries or materiel damage will not be exceeded with 99% assurance.

■ **least separation distances (LSD)** - separating a DGZ from preclusion vulnerability elements, to preclude damage or obstacle creation with 99% assurance.

■ **minimum safe distances (MSD)** - separating a DGZ from personnel safety elements, beyond which the level of weapon effects on friendly units is considered acceptable with a 99% assurance.

Solution view (see Figure 3) graphically displays these outputs, showing the calculated aimpoints (along with any manual aimpoints). Results for each solution set are summarized in a variety of tabulated reports:

■ **Aimpoint List Report** - catalogs all aimpoints in use, tailored to the current context.

■ **Optimized Aimpoint Sets Report** -Targets multiple weapons against multiple targets. Seeks to optimize by finding the minimum number of weapons to achieve the required coverage for each target.

■ **Target Cumulative Coverage Report** - lists cumulative probability of damage (PD) for each target, resulting from a set of aimpoints. It also lists the component PD contributed by each aimpoint.

■ **Preclusion & Collateral Damage Report** - lists all collateral damage and obstacle preclusion exclusions based on a specific weapon.

■ **FLOT & Personnel Safety Report** - lists all active FLOTS and personnel safety exclusions for a specific weapon.

Where Do You Obtain BNTO Training?

Personnel can use BNTO most effectively when they know the manual methods of Joint Pub 3-12.2. Then, they can appreciate and explain the

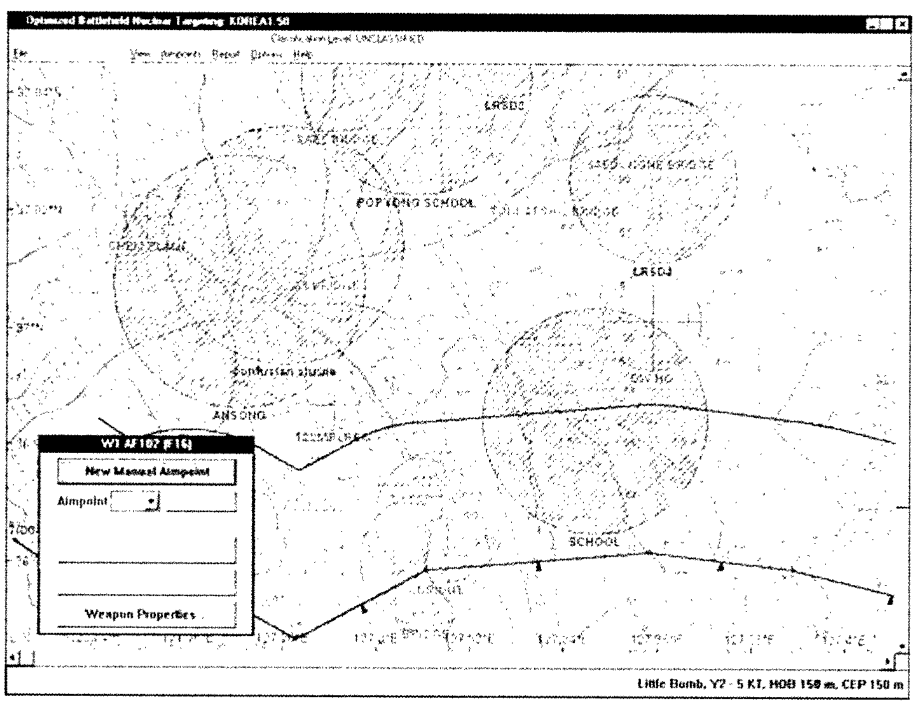


Figure 2. Weapon view of the nuclear case. Graphic shows exclusion zones for a specific weapon indicating if aimpoints may have to be offset to meet target damage requirements, and maintain exclusion safety distances.

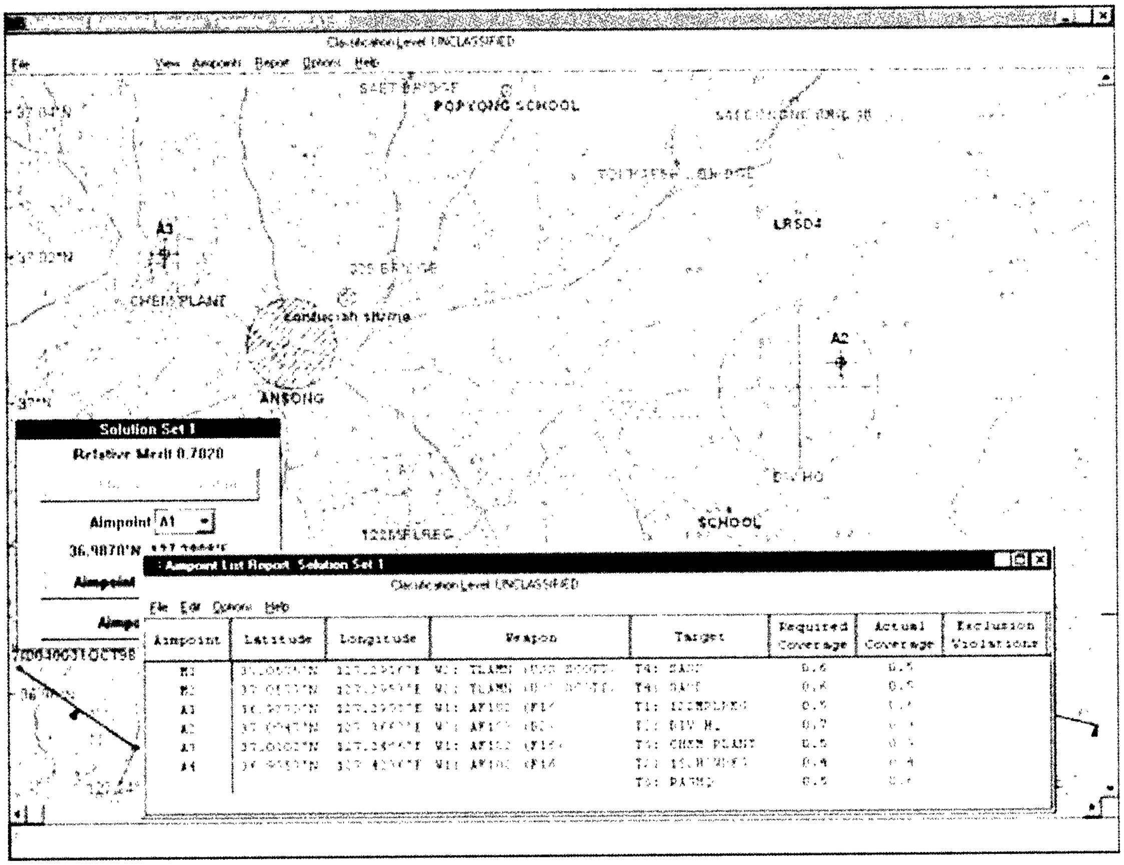


Figure 3. Solution view displaying targets and optimized aimpoints. The Aimpoint List Report relates aimpoints to targets and shows required and actual strike coverage.

what, why, and how, when BNTO performs its time-saving targeting and optimization schemes. Personnel receive the necessary training at the Joint Nuclear Operations and Targeting Course (JNOTC). The Defense Nuclear Weapons School (DNWS), located at Kirtland AFB, Albuquerque, NM, sponsors the course. For the latest JNOTC class schedule and quota information see the Bulletin Board on page13.

What's in the Future For BNTO?

The fielding of BNTO is only the beginning—USANCA and DTRA are already planning follow on efforts. DTRA is developing a BNTO interface with DTRA's Consequence Assessment Tool Set (CATS) (should be done by July 99). This will provide an integrated system capable of both nuclear target analyses and assessments of the longer-term nuclear hazards from a nuclear strike. As an added benefit, CATS can analyze biological and chemical hazards. DTRA is also working to ensure that users will be able to view BNTO/CATS outputs on vector maps, with their greatly expanded data views and capabilities.

The BNTO/CATS interface and vector map capability will allow unified commands, Army component commands and USANCA's NEAT to obtain enhanced consequence management information on offensive nuclear strikes.

How Do You Obtain BNTO?

BNTO is unclassified and available at no cost to DoD organizations by contacting:

Dr. Muhammad Owais
Defense Threat Reduction Agency
(703) 325-0459 owais@dtra.mil

The program includes a notional set of unclassified data so users can test program functionality. The unclassified data cannot be used for operational purposes. To make the program operational, users must contact USANCA to update and/or obtain the current/authorized version of classified (normally Secret Restricted Data) nuclear weapons effects data.

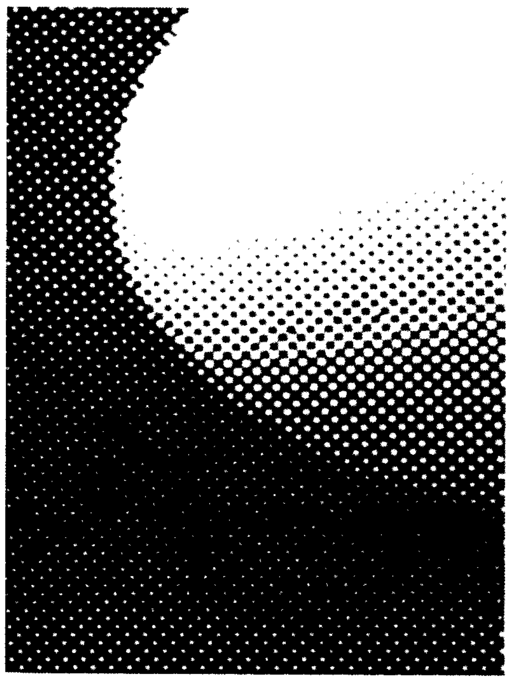
USANCA
contact information:

USANCA
7150 Heller Loop, Suite 101
Springfield, VA 22150-3198
Commercial
(703) 806-7860 / 7865
DSN
656-7860 / 7865
FAX
(703) 806-7900
e-mail
scott@usanca-smtp.army.mil

Non-Ideal Air Blast

Mr. Robert A. Pfeffer
Physical Scientist, USANCA

The characterization of air blast from a nuclear weapon detonation at a point on or near the earth's surface is very complex. In the 1950s, scientists used simple (ideal) descriptions of air blast phenomena. From these simple descriptions evolved more complex models to represent the weapon/atmosphere/earth/target interactions. Today, sophisticated codes and test facilities are able to approximate air blast phenomena, but they cannot accurately predict the onset of equipment damage under the conditions called non-ideal air blast (NIAB). Ideal air blast and NIAB are created under very different conditions, and they can have significantly different impacts on military system damage levels. This article briefly describes ideal air blast and NIAB, illustrates why these differences are so important, and concludes with an outline of the current Army/Defense Threat Reduction Agency NIAB program.



What are Ideal Air Blast and Non-ideal Air Blast?

An ideal air blast takes place in a standard atmosphere (one without unusual gaseous or particulate constituents), where interactions between the blast wave and the earth's surface are perfectly reflecting, or no energy is transferred into the ground. An example of such an ideal surface is solid ice. NIAB is created by mechanical means when the ground is not a perfect reflector (has roughness), causing the injection of dust or other materials, and by thermal radiation effects. The most severe NIAB occurs when the thermal radiation from the explosion produces a heated layer of air and vaporized surface material over the ground surface. The blast wave travels faster through the heated layer and a complex blast wave is formed which includes a high-velocity wind jet next to the surface. NIAB is most noticeable in a desert environment or on a dry, grassy plain.

Why are They Important to the Army?

Regardless of the surface over which a nuclear explosion occurs, air blast represents about half a weapon's total kinetic energy. This is why a nuclear weapon of, say 8 KT, can be simulated by a little more than 4 KT of ANFO (a mix of fertilizer and fuel oil). The fact that air blast represents such a large percentage of the kinetic energy causes it to be one of the primary kill mechanisms of Army equipment.

In general, nuclear-generated air blast is characterized at some distance from detonations as a plot of pressure versus time. A typical curve is shown in Figure 1. Energy transferred from the blast wave to a target can cause damage by crushing the target by the early-time high pressures of the blast wave, or through translation (movement) of the target by high winds in the blast wave, or both. For most equipment, the primary damage mechanism is translation. In these cases, the equipment are called drag-sensitive targets because they are translated by drag forces produced by the high winds in the blast wave.

When plotting equipment damage at arbitrary distances from ground zero, damage is plotted as a function of dynamic pressure impulse (DPI) versus ground range. DPI is the summation of the wind pressure versus time throughout the blast wave and correlates with the total drag loading produced on targets. A plot of DPI versus ground range is given in Figure 2 for a generic low-yield weapon. Two curves are plotted, one for the object on a reflective (ideal) surface, and one for

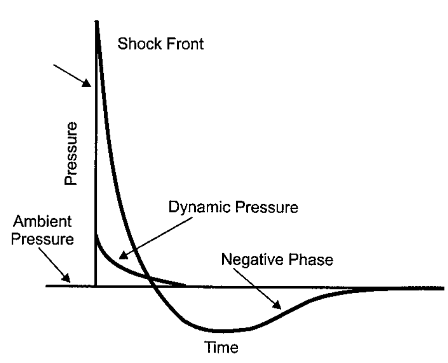


Figure 1. Typical Ideal Pressure-Time Curves.

the object on a surface where NIAB was produced by thermal radiation effects (heated layer). One can conclude that equipment damage estimates, based on the ideal DPI curve, significantly underestimate actual damage at the same ground range for NIAB. One can also conclude that a damage level occurring for ideal air blast will occur at a greater range for NIAB. These conclusions impact collateral damage and per-

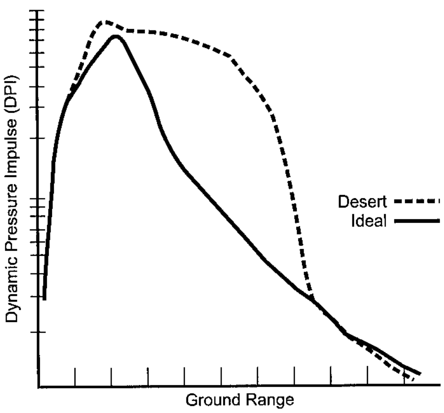


Figure 2. Typical DPI-Ground Range Curves.

sonnel safety estimates as well. For a discussion on these related topics, see NBC Report, Spring-Summer 1998, Joint Pub 3-12.2, Nuclear Weapons Employment Effects Data.

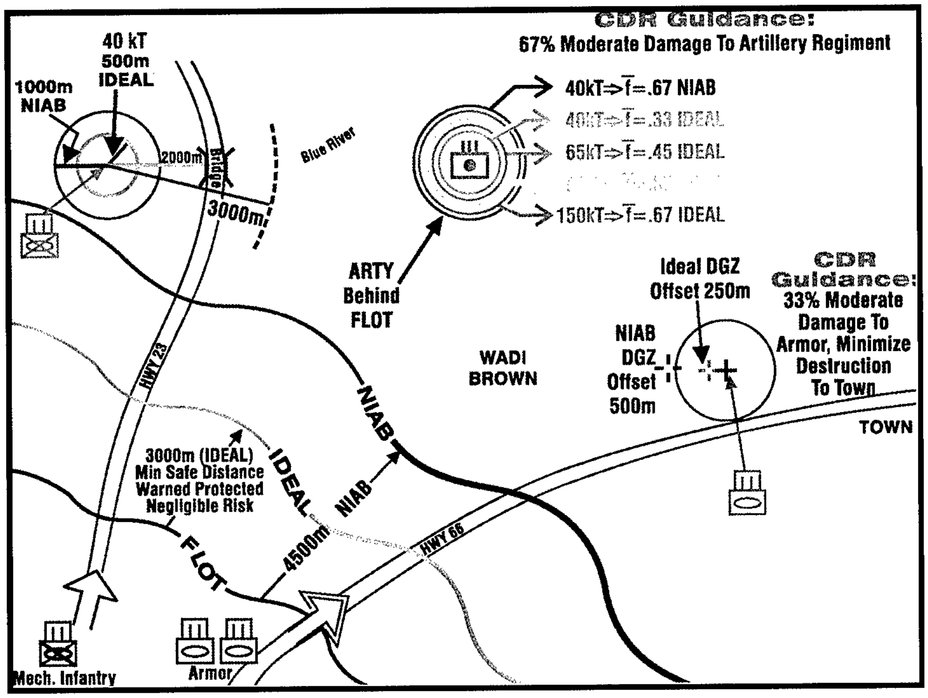


Figure 3. Field Operation of Ideal and NIAB.

Figure 3 illustrates the importance of accurate blast damage data for decision-making in the field. In attacking personnel, artillery, and tanks near bridges and towns, a commander must know the minimum yield options needed to destroy the enemy while minimizing collateral effects on friendly forces and non-combatants. Four separate examples are provided in the figure. Each provides a visual description of the difference between ideal and NIAB range calculations for hypothetical weapon yields.

The Non-ideal Air Blast [NIAB] Program

Historically, Army equipment survivability and lethality air blast testing was conducted under non-ideal conditions at the Nevada Test Site. With the cessation of atmospheric testing, less costly high explosive tests and air blast simulators have been used; unfortunately, they generate ideal air blast environments. One of the air blast simulators that is big enough to test equipment the size of helicopters, tanks, and trucks/shelters and yet can be modified to simulate the NIAB phenomenon is the Large Blast/Thermal Simulator (LBTS) (see NBC Report, Fall-Winter 1994, Large Blast/Thermal Simulator). Modifications include changing the pressure-tube firing sequence, relocating and constraining equipment under test, and improving test sensors and monitor systems. The final modification for testing equipment using a desert floor is scheduled for this year. It will now be possible to test large Army and foreign equipment including tanks, armored personnel carriers, and self-propelled howitzers on the desert surface just outside the LB/TS, allowing each to be exposed to a non-ideal air blast environment. See Figure 4. Such an environment approximates the DPI necessary for direct damage assessments for translating equipment, while sacrificing little of the overpressure characteristics which cause equipment crushing. The test data will be added to equipment damage databases to update damage prediction code capabilities following analyses.

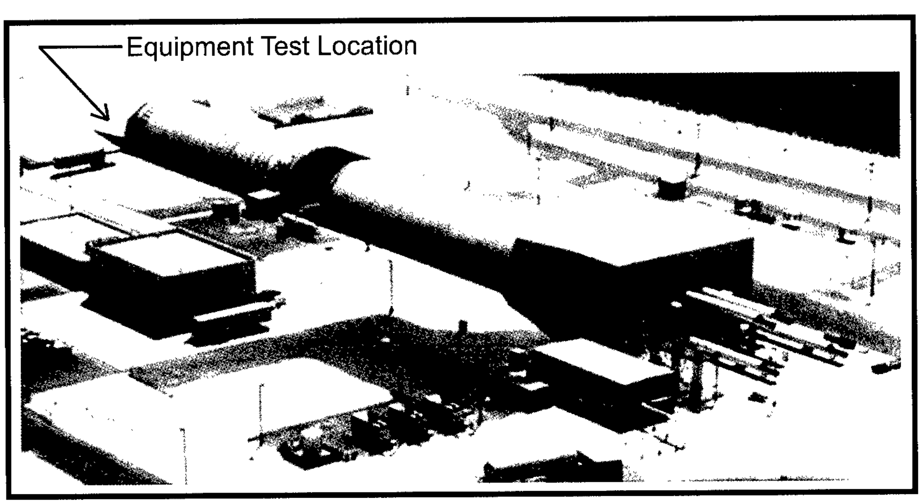


Figure 4. Equipment Location for LB/TS Test.

USANCA BULLETIN BOARD

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Class 99-3 13-17 Sep 99

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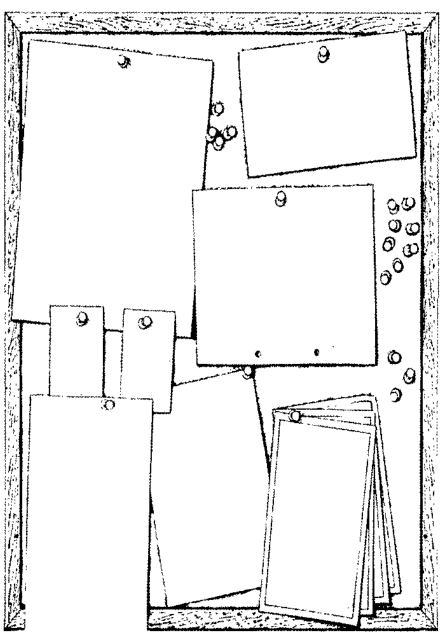
Army Specific Military Requirements for Nuclear and Radiation Effects Information

Provides DCSOPS-approved rank ordered list of requirements for information on:

- nuclear weapons effects
- related electromagnetic effects
- related directed energy effects

For a copy of the FY99/00 SMR contact
USANCA's Nuclear Division at (703) 806-7860 or DSN 656-7860



Personnel Risk and Casualty Criteria (PRCC)

The PRCC documents Army criteria for the personnel casualty effects of nuclear weapons and is a basic document for the nuclear weapons effects community. USANCA used the revised criteria in Joint Pub 3-12.2 nuclear targeting manual, nuclear survivability criteria, and radiation operational exposure guidance.

For more information, call USANCA's Nuclear Division at (703) 806-7860 or DSN 656-7860

Nuclear Research and Operations Officer Course (NROOC 99)

Functional area qualifying course for officers assigned to FA52

NROOC 99 15-25 Jun 99

Defense Nuclear Weapons School, Kirtland AFB, Albuquerque, NM

Attendance: Initial priority given to officers TDY enroute to a FA52 assignment or currently serving in a FA52 position.

Additional information/availability: Call the FA52 Proponent Manager, (703) 806-7866, DSN 656-7866.

Nuclear Employment Augmentation Team (NEAT)

USANCA's NEAT stands ready to provide nuclear target analysis and nuclear operational support to Army Corps and EAC HQs.

Specific NEAT capabilities include:

- ***Nuclear fire planning and target nomination***
- ***Analysis of effects of nuclear weapons use on theater land operations***

Units interested in scheduling NEAT support should contact USANCA's Operations Division at (703) 806-7857 or DSN 656-7857

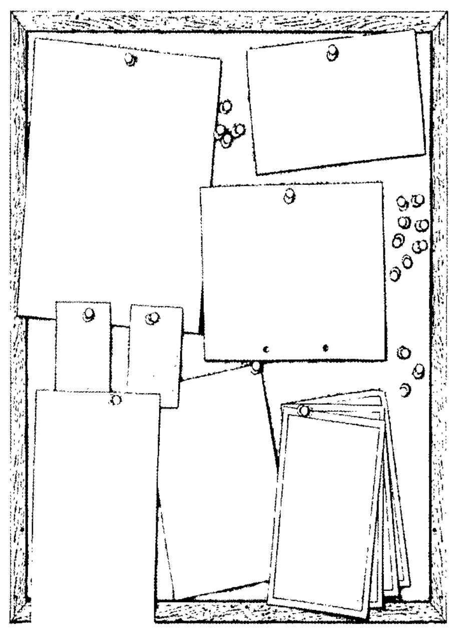
Defense Threat Reduction Agency

Interested in the community's latest reorganization

Check out DTRA's Website:
http://www.dtra.mil

Career Corner FA52 Opportunities at USMA Expanded

FA52 has received tentative approval from the Department of Civil and Mechanical Engineering, USMA to fill an instructor billet and a rotating Ph.D. billet. These positions are in addition to the FA52 billets currently found in the USMA Department of Physics. Selected FA52 officers would pursue an advanced degree in Nuclear Engineering prior to their assignment at USMA to teach mechanical engineering. FA52 officers interested in teaching at USMA should contact the FA52 Proponent Manager at DSN 656-7866 for additional information.

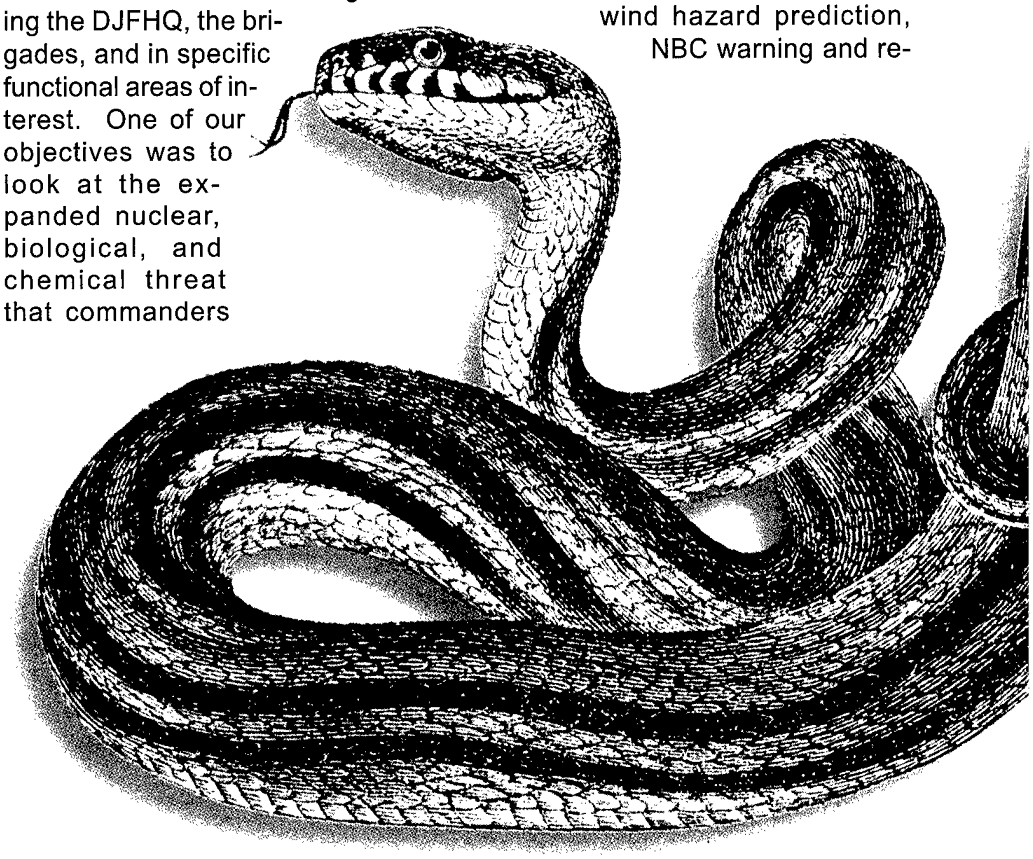


ABCA Exercise Rainbow Serpent 98 NBC Defense Lessons Learned

LTC Larry Panell, CM
NBC RSI Officer, USANCA

Capricornia enjoyed an excellent period of growth during the decade and a half leading up to its independence in 1951. However, during the next 30 years a slow decline began. This decline accelerated due to a series of internal initiatives set in motion in 1990 following the death of President Kubu. The subsequent partial disintegration of the People's Party of Capricornia (PPC) and weak coalition rule caused Capricornia to decline from Developing Nation to Third World Country. The national election in 1995 was aborted and the existing government continued to preside over the increasingly unstable and deteriorating situation under a self-declared State of Emergency. Following a series of bloody riots and clan-based internal fighting, the situation deteriorated to the extent that the UN sanctioned an Australian-led peacekeeping and monitoring operation to be mounted in October of 1998. By the time forces deployed, it became clear that the mission had become one of peace enforcement and commanders were forced to refocus their efforts. And so the story went . . .

Australia hosted Exercise Rainbow Serpent 98 (RS98), a joint coalition operational exercise, from 31 October to 12 November 1998. The mission was to evaluate deployable joint force headquarters (DJFHQ) and American, British, Canadian, and Australian (ABCA) brigade staff interoperability in a sanctioned operation other than war (OOTW) scenario. Evaluators reported observations and lessons learned regarding the DJFHQ, the brigades, and in specific functional areas of interest. One of our objectives was to look at the expanded nuclear, biological, and chemical threat that commanders may face during OOTW. Observations and lessons learned in the functional area of nuclear, biological, and chemical defense (NBCD) are provided below.

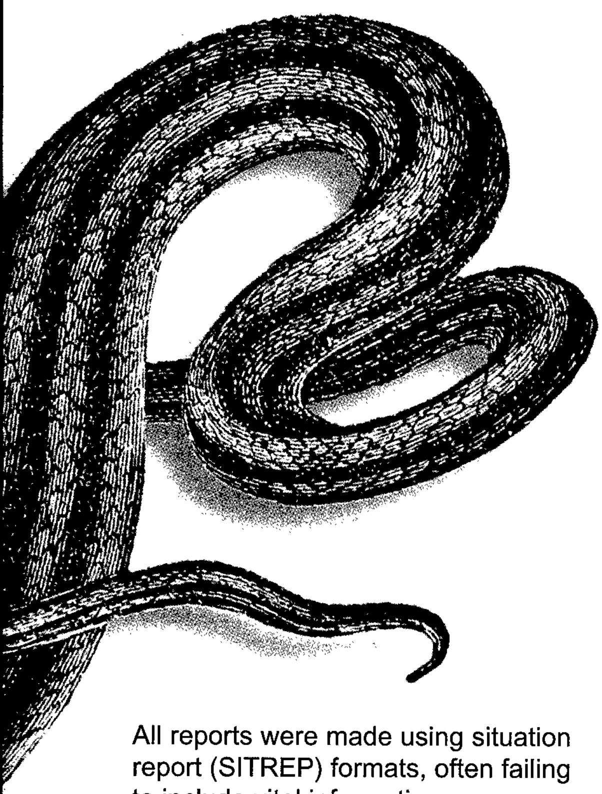


The Exercise

The exercise scenario was driven using a Master Events List (MEL) input by a controller cell. The MEL included three NBCD events. The first involved the theft of a quantity of radioactive material, later found as part of an improvised explosive device intended to exercise issues associated with low-level radiation (LLR) hazards (reconnaissance capabilities, force protection, and NBC warning and reporting). The second involved a toxic industrial chemical (TIC) release intended to generate downwind hazard prediction, NBC warning and reporting, and force protection assessments. The third involved the discovery of a cache of World War II mustard rounds, some of which were reported leaking, to raise issues concerning force protection, downwind hazards, NBC warning and reporting, and mitigation of the hazard. Controllers input details of the events, and evaluators and controllers observed and reported unit actions.

Observations

Some of the observations proved very interesting. Initial threat assessments included nothing about possible NBC threats to the force. Evaluators observed that this assessment would have resulted in some of the coalition forces deploying without individual protective equipment or unit NBC detection and identification equipment. Approved NBC warning and reporting formats were not used.



All reports were made using situation report (SITREP) formats, often failing to include vital information.

The DJFHQ did not have an organic NBC section, and the Australian, British, and Canadian forces included NBC as part of their engineer operations, according to their doctrine, using officers who perform NBC tasks as an additional duty. Staff personnel stated that NBC reporting is done through operational channels, but no capability was observed to effectively receive, process, and disseminate NBC information to subordinate formations.

None of the commands established exposure guidelines or protective postures during the exercise. Evaluators questioned operational and medical personnel about guidelines and found they were familiar with these requirements; however, it appeared they were unsure regarding how and when to establish them.

Lessons Learned

Despite what may sound like a rather grim situation, evaluators and controllers observed a cooperative attitude among players who provided valuable candid feedback. As the exercise began to wind down, we discovered a number of valuable lessons.

- Procedures are needed to assess the threat posed by NBC hazards in operations other than war (OOTW). Planners must learn to "look outside the box" when assessing the threat posed to forces in situations such as the one portrayed in RS98. Traditional clues are not present, and belligerents are likely to use whatever means are available for creating weapons and making their point with violence. Some of these may involve NBC materials. Commanders must ensure that soldiers are adequately protected and equipped to deal with the hazards they may face.

- Standard NBC warning and reporting systems are in place in Quadripartite Standardization Agreements (QSTAGs) and should be used in all situations when appropriate. NBC warning and reporting systems ensure that the proper information is passed efficiently when a chemical, biological, or nuclear threat appears in the theater of operation. Standardized reports enable operators to pass information quickly and accurately without having to transcribe or translate the information into unique national formats. Standardized reporting is essential when coalition forces are operating at different levels of experience and capability, particularly when personnel responsible for collecting and passing the information are not NBC experts and are unaware of the significance of the information being passed.

- Under the "Lead Nation" concept, it may be necessary to establish a basic command structure model based on required capabilities (e.g. engineer, fire support, EOD, NBC, etc.). The Lead Nation Commander can assess what capabilities he brings with him and determine what limitations or shortfalls (staff specialties, communications, etc.) may exist in his structure. Other ABCA nations could provide assets to fill these limitations and shortfalls, plan and train for their use, and establish procedures to improve interoperability.

- Participating nations need to increase the awareness of QSTAGs within their forces. Evaluator and player feedback indicated that many participants were not aware QSTAGs existed. Several evaluators stated that QSTAG procedures should be embedded in the national doctrine and thus, invisible to coalition forces. In reality, each nation follows its own doctrine, but commanders and staffs participating in quadripartite coalition operations must be familiar with the agreements that exist. Nations may choose to adopt the QSTAG procedures and make them part of their national doctrines when appropriate, but when this is not the case, decisions must be made to modify procedures to enable forces to operate together effectively. Commanders make these modifications in the unit's standing operating procedures (SOPs) and operational plans and orders (OPLAN/OPORD) as required, to avoid placing additional burdens on the soldier in the field.

Conclusion

Exercise RS98 provided an excellent opportunity for ABCA forces to work together and to learn from their respective experiences in OOTW. It also provided a unique backdrop for highlighting the types of NBC threats that allied forces might face in these types of operations. The primary threat no longer comes from a single source with a fully documented capability to employ weapons according to a doctrine developed from years of testing, training, and implementing. Today's threat is complex and has many uncertainties. The ability to protect the force across the spectrum of conflict possibilities requires commanders to recognize the wide range of dangers that these forces may face.

Commercial Off-The-Shelf Equipment Survuvability In High-Altitude Electromagnetic Pulse Environments

Major Brent B. Bredehoft, FA
Nuclear Effects and Survivability Officer, USANCA

In today's environment, the Army is designing, producing, upgrading, modernizing, and maintaining systems with an increasing percentage of commercial off-the-shelf (COTS) and non-developmental item (NDI) equipment. Recently, there has been concern that COTS and NDI equipment will not meet high-altitude electromagnetic pulse (HEMP) survivability requirements without huge expenditures of scarce procurement dollars. This is a myth—the Army has been using COTS in battlefield equipment for years. When the Army tested and designed these systems with an electromagnetic environmental effects (E3) perspective in mind, they met the survivability criteria of MIL-STD-2169B, "High-Altitude Electromagnetic Pulse (HEMP) Environment." Hardening to survive HEMP effects is necessary due to the large damage effects radii (thousands of kilometers) extending from a single high-altitude nuclear burst. Failure to harden against HEMP could result in the loss of all, or a large number of, systems throughout a theater of operations.

This article briefly discusses the methods of testing for HEMP survivability, recent examples of Army systems with COTS and NDI equipment/components economically meeting HEMP survivability requirements, and recent test results of the susceptibility of COTS computer and audiovisual equipment to HEMP-like environments.

The Army's HEMP Survivability Testing Methodology

The Army does not normally test COTS/NDI equipment, per se, in isolation, but tests mission critical components/systems consisting of COTS/NDI equipment to determine if they meet HEMP survivability criteria specified in MIL-STD-2169B. The Army conducts tests to determine if a component or system survives at a certain level, not to determine at what level it fails. The ability to survive HEMP is primarily due to adequate electromagnetic shielding and protection schemes, which include HEMP hardening features. As demonstrated on many Army systems, it is not difficult or costly to meet HEMP survivability criteria. Failures are configuration influenced and are due to large amounts of electromagnetic energy rapidly coupled onto antennas and cables with most of that energy conducted as electricity to electronics. The effect is similar to those from lightning strikes.

The Directorate of Applied Technology, Testing and Simulation at White Sands Missile Range uses the following methodology to test a system's vulnerability to HEMP:

- From years of experience with economical hardening techniques, it analyzes the system design and configuration, looking for any noticeable weaknesses, apertures, and coupling paths that may negatively affect the system's ability to meet the criteria.
- If no weaknesses are found in the analyses, the system is instrumented and tested at 75%, 100%, and 125% of the peak electric field using the MIL-STD-2169B waveforms.
- If weaknesses are suspected during the analyses, the system is tested at 25%, 50%, 75%, and 100% of the peak electric field using the MIL-STD-2169B waveforms.
- Current is injected at the point of entry on systems with long cables or antennas to ensure that potential HEMP coupling through these "ports" is adequately replicated.
- If a failure is detected at any level, the system is analyzed for the point of failure to determine if the system can be fixed to meet the standard. If the system can be fixed or modified "on-the spot," then the testing continues until the system demonstrates the ability to meet MIL-STD-2169B criteria.

HEMP Survivability of COTS Equipment/ Components in Army Systems

The Army has been using COTS equipment for many years. Some of this equipment, without any further engineering, meets established HEMP survivability criteria. Others initially fail when subjected to HEMP tests, but with minor and inexpensive fixes can meet the criteria. Some fail HEMP tests, if tested separately. However, when COTS equipment is incorporated into well-engineered systems, the systems are able to survive the HEMP environment regardless of the hardness of the COTS components. Some recent examples of the Army's use of and testing for components/systems with COTS demonstrate these points:

- The on-going M1A2 System Enhancement Program uses COTS for 123 of 169 critical hardware items. The M1A2 Abrams has increased from approximately 30 to nearly 100 COTS items in four years of production. These parts have been tested at the box and system level. The system meets MIL-STD-2169B criteria.
- The Command and Control Vehicle (C2V), which has numerous COTS electronic devices and components, shop-repairable units, and line-replaceable units, was tested to and meets MIL-STD-2169B criteria.
- The Tactical Communications Interface Module (TCIM), a COTS item consisting of Motorola DSP56002S

and MC3836C processors, is in systems that use the Common Hardware System (CHS). The TCIM has only been ruggedized for shock and vibration. When inserted into a system using CHS such as Paladin, Striker, Bradley Fist Vehicle, and C2V, the TCIM meets MIL-STD-2196B criteria.

- GPS equipment, consisting primarily of COTS items, such as the PLGR and GEM III, is found in numerous configurations and in many systems such as Joint STARS, M2A3, M109 Paladin, NBC Reconnaissance Vehicle, Bradley Fist Vehicle, Striker, and ATACMS. The PLGR meets MIL-STD-2196B criteria. However, when the PLGR is integrated into certain systems with cables, antennas, and other points of entry for HEMP-generated phenomena, failure results at very low HEMP electric field levels. Proper E3 engineering eliminated the failure mode, and the system currently meets MIL-STD-2169B criteria.

- The Automated Fire Control System-XXI (AFCS-XXI) of the M109 Paladin is built around the automated control unit, a ruggedized COTS item, which replaced three line-replaceable units and saved the government $21 million. The AFCS-XXI, as part of the Paladin system, meets MIL-STD-2169B criteria without any additional engineering.

- A bus transfer switch (BTS) box, a COTS item, was added to the Tactical Quiet Generator (TQG) to create the power plant configuration. During system-level testing, the BTS failed at a low level. Following the addition of a 0.1mf capacitor and metal oxide varistor to the circuit ($4.00 each), the TQG meets MIL-STD-2169B criteria.

- An RS-422 Bus used in Joint STARS initially failed its HEMP test. Addition of a low-capacitance transorb ($20) allowed the system to meet MIL-STD-2169B criteria.

- A main control box used in the Palletized Loading System (PLS) initially failed its HEMP test. Addition of transorbs and creative use of ferrite beads (total of $100 per vehicle) allowed the PLS to meet MIL-STD-2169B criteria.

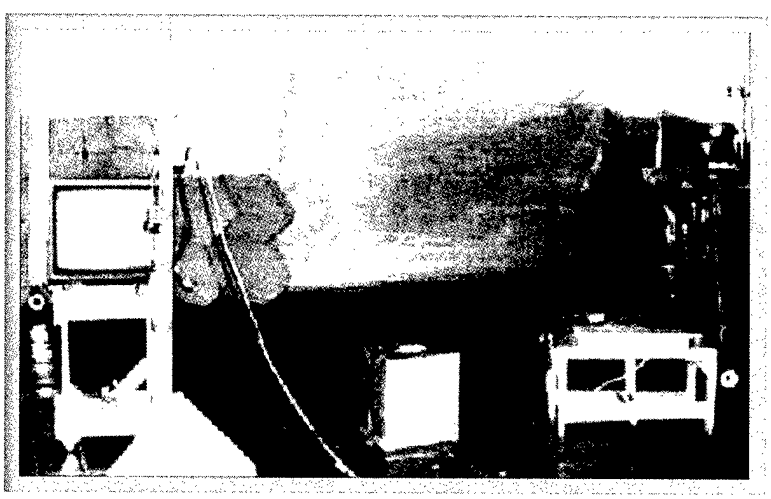
C4I Systems' Vulnerability to HEMP

In response to increased interest in the vulnerability of COTS equipment to HEMP, the Test and Evaluation Command at White Sands Missile Range (WSMR) and the Defense Threat Reduction Agency (DTRA) tested six computer-type systems in September and November 1998. The goal of the tests was to identify the onset of anomalous system behavior due to HEMP exposure. In the November tests, to demonstrate the mitigation from using the common techniques of turning-off or unplugging systems, the test examined each system unplugged, plugged in but not powered, and plugged in with power on. After each test in which system power was off, the system was powered up and the status of the system evaluated.

Constraints in the HEMP field-source generator limited the output levels to discrete field strengths of 0.5, 1, 2, 4, 8, 16, and 32 kV/m (+/- 20%). System behavior was noted as the peak E–fields were stepped up. Because of the discrete levels tested, if anomalous behavior occurred, the actual onset of that behavior could have occurred anywhere between the level where testers first noted the behavior and the previous lower-level tested.

Testers noted four system/subsystem behaviors: (1) no noticeable effect – no impact on functional operation or mission; (2) temporary upset that self-recovers – mission impact dependent upon subsystem function and mission; (3) latch-up requiring human intervention – mission impact dependent upon subsystem function and mission; and (4) permanent damage – mission impact dependent upon mission. A summary of equipment tested and results are reflected on the graph at figure 1.

System 1 consisted of a 29" Mitsubishi RGB monitor, RGB 109+ VGA interface, ADA-2-300HV distribution amplifier, VICON video camera, videocassette recorder (VCR), and 386 computer. Testers noted the following system behavior as peak E–fields increased: at 1 kV/m, the RGB monitor experienced temporary upset; at 2 kV/m, the VCR and 386 computer respectively experienced latch-up that required operator intervention; and at 8 kV/m and 4 kV/m, the VCR and 386



System 1: Video Subsystem
29" Mitsubishi RGB monitor
RGB 109+ VGA interface
ADA-2-300HV distribution amplifier
VICON video camera
Video cassette recorder
386 computer

computer experienced permanent damage. Other system components (RGB 109, amplifier, video camera) experienced no effect from levels up to and including 32 kV/m.

System 2 consisted of a CISCO Catalyst 300 router, a Pentium 75 (P-75) computer, a 486 computer, and a 386 computer used as a controller. The computers were initially tested with cables detached and then hooked together in a LAN configuration using the CISCO router to evaluate the effects of HEMP on the router and the overall local area network (LAN). Peak E-field output levels were stepped up consistent with system 1 testing: at 1 kV/m, the 386 experienced upset that required operator intervention to correct; at 4 kV/m, the P-75 experienced temporary upset that self-corrected; at 8 kV/m, the P-75 and the 486 experienced upsets that required operator intervention to correct; and at approximately 16 kV/m, the CISCO router and P-75 experienced permanent damage. The system, as a whole, experienced upsets in flow of information in the LAN at or before 8 kV/m; the system was not tested between 4 and 8 kV/m output levels.

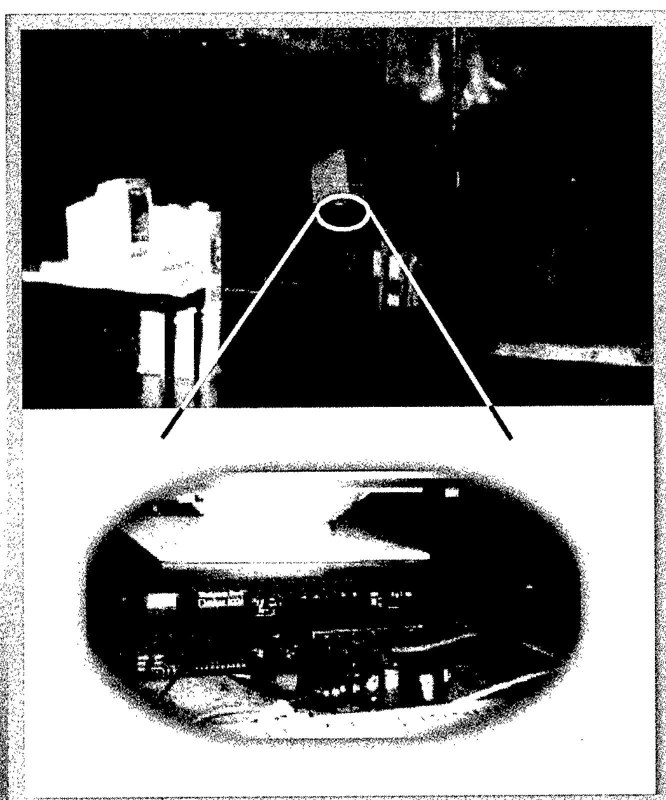
System 3 consisted of a Zenith 486 Desktop Computer, Zenith Keyboard, Logitech Mouse, and Orchestra Color Monitor. Up to 32 kV/m, there were no noticeable effects. At 32 kV/m, while unplugged, or plugged in and not powered, there were no noticeable effects. At 32 kV/m, while powered, the CPU and monitor experienced permanent damage. The CPU was repairable.

System 4 consisted of a Positive 386 Desktop Computer, Positive Supertron Monitor, Positive Keyboard, Logitech Mouse, Motorola Universal Data Systems Modem, and Kodak Dieconix 180 SI Ink Jet Printer. Up to 16 kV/m and with no power on, there were no noticeable effects. Powered at 16 kV/m, the computer and printer experienced upsets that required operator intervention to correct. Powered at 32 kV/m, the modem experienced upsets that required operator intervention to correct. With no power at 32 kV/m, there were no noticeable effects.

System 5 consisted of a Commodore Amiga Desktop with a Motorola 6800 (7.16 MHz) processor and Commodore Color Monitor. No noticeable effects were observed at any level or power configuration.

System 6 consisted of a Texas Instrument 386 Laptop and power supply. While unplugged at 2 kV/m, the system experienced permanent damage. The system would not boot, the low battery light flashed, and the monitor burned out.

These test results demonstrate that it is not possible to state categorically the vulnerability of COTS computer systems to HEMP. Some systems and components survived up to 32 kV/m, while others experienced upsets and failures at very low levels. Tests 3 through 6 show that turning power off does increase a system's ability to survive a HEMP event. Vulnerability to HEMP is also highly configuration dependent.



System 2: 386 Computer in Screen Box

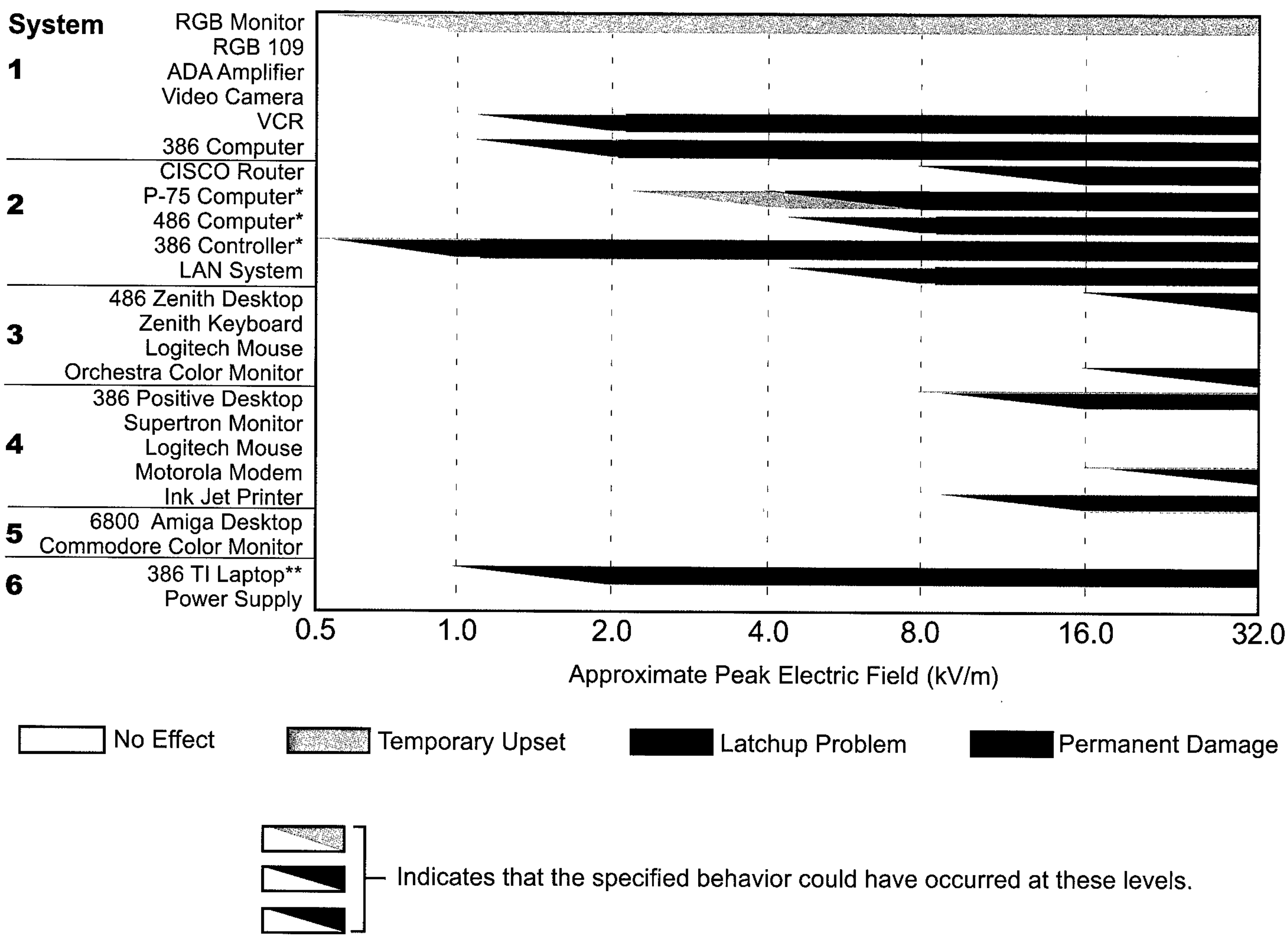
System 3: CISCO Router Subsystem
Top Photo
CISCO Catalyst 3000 router
Pentium 75 (P-75) computer
486 computer
386 computer
Bottom Photo
CISCO Catalyst 3000 router

Without testing a specific system in its intended operational configuration, it would be extremely difficult to determine its vulnerability to HEMP.

Conclusions

The Army is making maximum use of COTS equipment to increase capabilities, to increase parts availability, and to save acquisition costs in battlefield systems. As demonstrated, systems with effective design, and if required, nominal modifications, will survive HEMP levels specified in MIL-STD-2169B. Since a system's ability to survive HEMP is based on its E3 shielding/protection schemes and its operational configuration, the Army no longer tests individual parts or components. Instead, the Army generally tests all assembly levels of COTS equipment embedded in systems at the system level, to ensure overall system survivability. Also, because of the dependence between configuration and energy coupling, without testing, the Army will not know whether its systems will survive the HEMP threat. The overriding concern is that battlefield systems are properly designed, configured, and tested to survive the anticipated threat, as identified in DoD-approved MIL-STD-2169B.

Figure 1. COTS C4I HEMP Survivability Test Results



NOTES: Systems were tested at the approximate 0.5, 1, 2, 4, 8, 16, and 32 kV/m levels only. System changes were noted at the tested levels.
Unless indicated, results shown are with power supplied to the system.
*Testing done without cables connected.
**Power was off, system was unplugged.

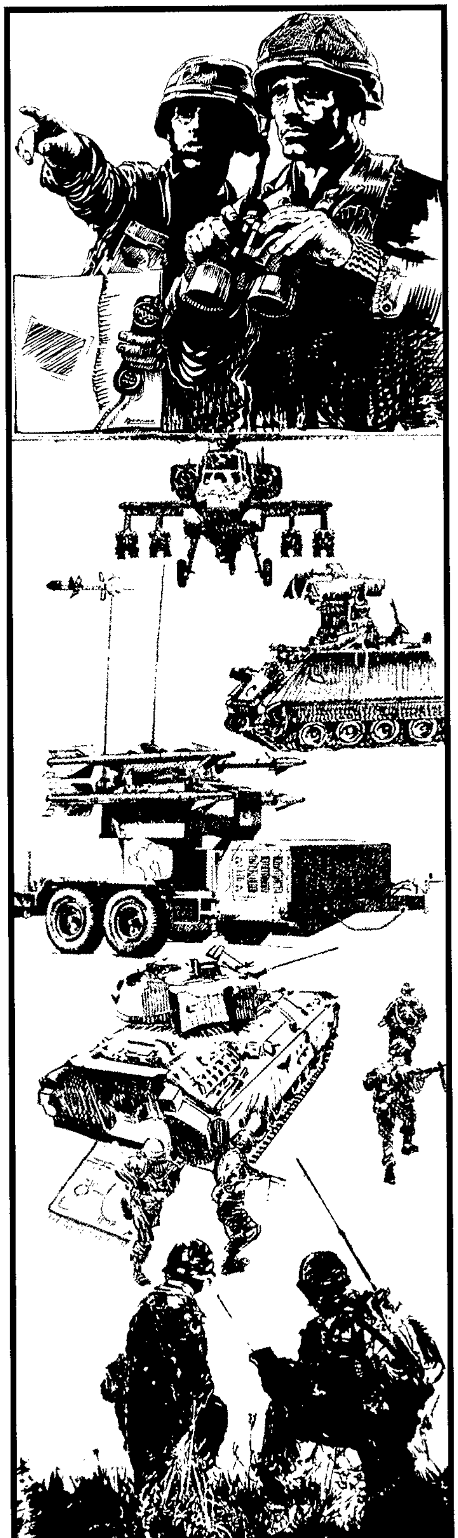
Survivability of Army Personnel and Materiel

Mr. Warren Dixon
General Engineer
NBC Survivability Action Officer
HQ TRADOC

On a battlefield, the ability to live and to operate after experiencing initial nuclear effects or nuclear, biological or chemical (NBC) contamination does not happen without proper preparation and training. Nuclear Survivability (NS) and NBC Contamination Survivability (NBCCS) are planned... or sadly, in some cases, not.

DoD Regulation 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs, dated 15 Mar 96, directs "mission critical systems be survivable to the threat levels anticipated in their operating environment." The Army implements this direction in AR 70-75, Survivability of Army Personnel and Materiel, dated 10 Jan 95, which requires all mission essential or critical items to be nuclear, biological, and chemical contamination survivable and, as a minimum, high-altitude electromagnetic pulse (HEMP) survivable.

Currently, most operational requirements documents simply state that the mission critical system has NBCCS, NS, or HEMP survivability requirements. This is commonly interpreted to mean the entire system and all its components must be survivable. This is not necessarily the case. The combat developer must specify which subsystems or system functions are essential/critical and which components must perform those functions. These are the components that must be survivable. Additionally, NBCCS and NS requirements are often interpreted to mean a materiel-hardening requirement. This also is not necessarily the case. In some cases, tactics, techniques and procedures can be developed to meet hardness requirements. In other cases, redundancy or logistical solutions can suffice. Still in other cases, only certain configurations will require system or component hardening.



TRADOC PAM 71-9

To provide combat developers guidance to identify what system components are mission essential or critical and then how to determine the technique which will best meet the hardening requirement, TRADOC published TRADOC Pam 71-9, "Force Development Requirements Determination," 1 Aug 98. TRADOC Pam 71-9 describes the process for determining, documenting, and approving materiel warfighting requirements.

Appendix I, "Materiel Requirement Document (MRD) Formats," defines the contents of requirements documents used to procure Army materiel. Appendix I indicates that paragraph 4c, "Other System Characteristics," of an Operational Requirements Document (ORD) is the proper location for NS and NBCCS requirements. This section also refers the reader to Appendix S for additional information on NS and NBCCS. Appendix S, "Survivability of Army Personnel and Materiel," establishes TRADOC policies, responsibilities, and procedures for implementing NS and NBCCS within this process. With the inclusion of Appendix S, TRADOC Pam 71-9 superseded TRADOC Reg 71-14, "Force Development Procedures for Implementing Nuclear and NBC Contamination Survivability into the Development and Acquisition Process," dated 14 Sep 84.

Balancing Survivability Requirements

A primary objective of Appendix S, TRADOC Pam 71-9, is to specify balanced survivability requirements. Whether written on the East Coast or the West Coast, whether written by an

experienced or inexperienced author or by authors of different functional areas, the process needs to yield survivability requirements that are cost effective, prudent, and balanced with other systems on the battlefield. A simplistic way to view the objective is to compare it with the fast-food industry. A signature burger by a national chain will taste the same on both the East and West coasts, because the expertise of preparation is in the process, not the cook. However, in a Mom-and-Pop type grill, a burger at one place will taste different than a burger down the street. In this case, the expertise is in the cook, not the process. In a similar way, combat developers, regardless of their background, need a process to establish survivability requirements which yield similar and balanced results on the battlefield... at an affordable cost and with approaches that are realistic and possible to achieve.

To prompt combat developers of varying backgrounds to produce balanced requirements, the theory within Appendix S is to establish a consistent thought process. With this in mind, Appendix S encourages combat developers to prepare a matrix with the various critical platform functions (extracted from the Operational Mode Mission Profile) along the left vertical edge and the applicable aspects of NS or NBCCS across the top. At the intersecting blocks, the combat developer generates solutions for the particular function in the particular environment. These solutions should first address non-materiel approaches such as tactics, techniques and procedures (TTP), doctrine or training. If a solution cannot be achieved using these techniques, then a materiel solution, such as overpressure or hardening, is used.

The matrix goes further than just helping to determine solutions. For example, if a TTP solution is to decontaminate an entrance hatch immediately prior to entry, then the combat developer needs to ensure the platform has some type of decontamination apparatus available to complete the TTP. Furthermore, the combat developer needs to ensure training and operations manuals address these procedures. If hazards remain after completing a procedure such as decontamination, the combat developer must identify these hazards in appropriate manuals.

Materiel developers are charged with implementing the NS and NBCCS requirements identified by combat developers; if a requirement cannot be met, per AR 15-41, the issue needs to be presented to the Secretariat of the Nuclear and Chemical Survivability Committee for review and possible waiver consideration.

Summary

In summary, Appendix S of TRADOC Pam 71-9 takes a more practical and realistic approach to NS and NBCCS than previously existed. It recognizes that no system is perfectly survivable. As such, materiel developers need to acknowledge that fact and develop work-arounds for system shortfalls. Soldiers need to be educated on the best approach to use the system in contaminated environments. Most important, materiel developers need to inform their leadership where any shortfalls and/or hazards exist so soldiers can effectively use the system with success in a contaminated environment.

Example Nuclear Survivability and NBC Contamination Survivability Matrix

Critical Function in System Deployment Configuration	Threats				
	HEMP	**Rad Contaminants**	**Personnel BIO Hazard**	**Chem Vapor**	**Chem Liquid**
From shipping, storage, or staging deployment configuration must remain postured for move-out functions without additional preparation.	TTP (Power Off)	TTP (Cover)	TTP (Button up) & Bleach Harden	TTP (Button up) & Vapor Harden	TTP (Cover)
From move-out operations must remain capable to set-up for operations without maintenance.	Survive HEMP (TTP for Weapon: Power Off)	Compatible (Overpress, MOPP-4) Rad hard	(Compatible (Overpress, MOPP-4) BIO hard	Compatible (Overpress, MOPP-4) Vapor hard	Compatible (overpress, MOPP-4) Liquid hard
While "shoot, move, & communicating", must remain able to shoot, drive, and manually reload.	Survive HEMP, loss of auto-reload OK	Compatible (Overpress, MOPP-4)	Compatible (Overpress, MOPP-4) BIO hard	Compatible (Overpress, MOPP-4) Vapor hard	Compatible (Overpress, MOPP-4) Liquid hard

TRADOC Pam 71-9
Can Be Found At:
http//www.tradoc.monroe.army.mil/dcscd/pubs.htm
Look Under "TRADOC Pamphlets," Then Scroll Down To 71-9.

ARMY REACTOR OFFICE RECENT CHALLENGES

Major Brent B. Bredehoft, FA
Assistant Manager, Army Reactor Program, USANCA

The Army Reactor Office (ARO) serves as the focal point for day-to-day management of the Army Reactor Program. It interacts and coordinates with the Department of Defense (DoD), the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), and other federal, state, and Army agencies involved in the Army Reactor Program. It issues the permits and certificates for operation of Army reactor facilities, participates in audits, and oversees operation and management of operational, deactivated, and decommissioned reactor facilities. The objectives of the Army Reactor Program are:

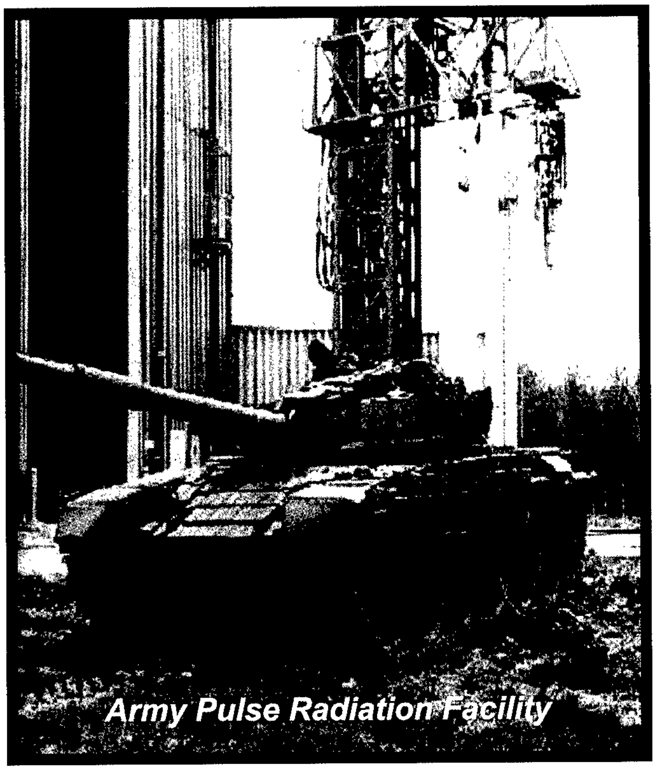
- To maintain radiation exposure to the public, environment, and operating personnel within regulatory limits and as low as reasonably achievable.
- To minimize the probability of a reactor accident or incident.
- To minimize the consequences of a reactor accident or incident.
- To ensure adequate security of reactors.

Currently, the ARO oversees the activities of six reactors: two operating fast-burst reactors at White Sands Missile Range and Aberdeen Proving Ground; three deactivated power reactors located at Ft. Belvoir, Ft. Greely, and on the Barge, Sturgis, in the James River Reserve Fleet; and a deactivated research reactor at the old Diamond Ordnance Radiation Facility in Maryland. The oversight of these diverse facilities has offered some unique challenges for the ARO. This article highlights some of those challenges and accomplishments.

Fast-Burst Reactors

In the last year, the ARO has reviewed and analyzed the safety features of the two operational fast-burst reactors' designs, facility technical specifications, and procedures to ensure the systems meet Army Reactor Program objectives. The Army's reactor policy is to follow, to the maximum extent possible, the regulations of the U.S. Nuclear Regulatory Commission and to ensure that Army reactors are designed, constructed, operated, maintained, and decommissioned per U.S. national standards. Therefore, the ARO adopted the NRC's review methodology presented in the Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, "Standard Review Plan and Acceptance Criteria," NUREG 1537, Part 2, February 1996. The ARO chose portions of NUREG 1537 that apply to fast-burst facilities and utilized the listed acceptance criteria, review procedures, and evaluation finding requirements detailed for each area.

After a comprehensive review of the documentation submitted by reactor staffs, the ARO found that overall the Army's fast-burst reactors are reliably and safely meeting the Army Reactor Program objectives. However, the Safety Analysis Reports (SARs) and Accident Analyses for each of the facilities need updating to meet current guidelines. Many extant analyses date back to original


Army Pulse Radiation Facility

efforts completed prior to the reactors becoming operational and supplemented with numerous special safety studies. The reactor staffs have committed to preparing their SARs by July 2000 as a condition for continued operation.

Closure of the Army Pulse Radiation Facility (APRF) Reversed

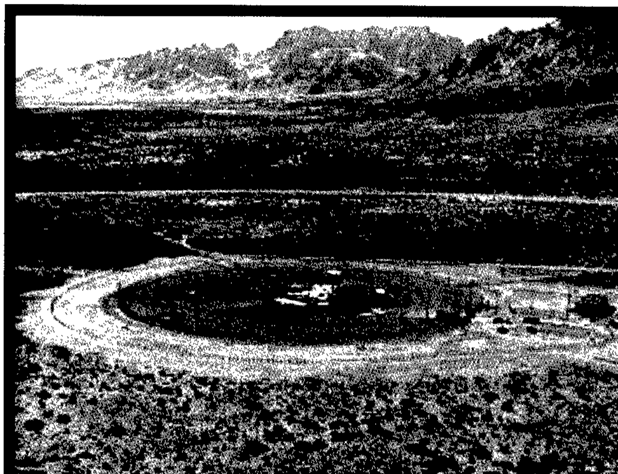
In February 1998, HQDA approved a TECOM proposal to shutdown the APRF at Aberdeen and to consolidate reactor capabilities for nuclear effects testing at the White Sands Missile Range-Fast Burst Reactor due to operating budget shortfalls, declining

customer base and testing requirements, and loss of Military Police (MP) personnel for the security force. HQDA, OSD, and the facility's customers debated the proposal for closure for several months prior to HQDA's decision. During this time, the ARO proceeded with normal activities, assuming the facility would remain open, so that appropriate documentation would be in place to support operations if HQDA decided to maintain APRF. Similarly, TECOM only implemented reversible actions in preparing for closure until HQDA made the decision. Based on HQDA's final decision, TECOM sent the ARO formal notification of its intent to decommission the APRF on 21 September 1998 and began to take permanent shutdown actions. However, in January 1999, the Director of Defense Research and Engineering, on behalf of the Ballistic Missile Defense Office (BMDO), asked the Deputy Under Secretary of the Army for Operations Research to keep APRF operational. BMDO is providing funding for APRF through FY99. The Deputy Under Secretary directed APRF to halt permanent shutdown activities while BMDO conducts an assessment of its survivability testing requirements for which APRF may be the exclusive provider of the required radiation environments.

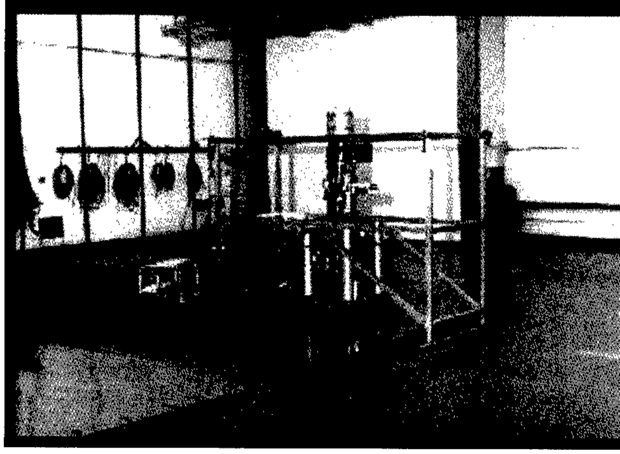
The earlier decision to shutdown the APRF reactor invoked requirements for fuel shipments, for changes to facility technical specifications, and for decommissioning studies which needed to be coordinated with the ARO and approved by the Army Reactor Council, Office of the Deputy Chief of Staff for Operations and Plans (ODCSOPS), and the Department of the Army Safety Office (DASAF). These activities have now been shelved pending the BMDO assessment of its requirements.

Deactivated Power Reactors

The three deactivated power reactors ceased operations in the early to mid-1970s. The U.S. Army Corps of Engineers (COE) removed and transported reactor fuel and high activity materials to DOE facilities for final disposition. The COE also decontaminated areas outside the containment vessel, entombed the containment vessel and adjacent areas of the Ft. Greely reactor, and secured the containment vessel and adjacent areas of the Ft. Belvoir and Sturgis reactors. At deactivation, a decision was made to allow up to 50 years for radioactive decay to make decommissioning easier at a future date.



White Sands Missile Range Fast Burst Reactor



Reactor Disposition Study

On behalf of DCSOPS, the ARO contracted with Science Applications International Corporation (SAIC) for a comprehensive study to evaluate options for the final disposition of the three deactivated COE power reactors. This study analyzed the status of the three deactivated reactors in relation to existing laws and regulations and estimated the costs of future management options for the facilities. The study evaluated three future management options:

- Cleaning to "greenfield." Greenfield is decommissioned and decontaminated so the facility can be restored to unrestricted use.
- Cleaning to "brownfield." Brownfield is decontaminated so the facility is suitable for restricted use. Contamination is still present, but contained, and requires continuing management to limit exposure to the public.
- Remaining at "status quo." This is continuing in the current condition.

The study found that the facilities are safe in their present configuration, but will never be releasable for unrestricted use simply by allowing time for radioactive decay, even though there has been significant reduction of residual radioactivity since deactivation. The study also found the facilities in compliance with existing environmental and safety regulations and laws and that the Ft. Greely and Sturgis reactors are currently already in a "brownfield" status. The study demonstrated that the cost to decommission the facilities will escalate drastically the longer the Army waits because of rising radioactive waste disposal costs and ever tightening regulations. Detailed hazards surveys are required to determine better cost estimates for specific budget and contracting proposals.

The ARO presented the study to the DCSOPS and the Deputy Chief of Engineers on 12 May 1998 with the following recommendations:

- Conduct the hazard assessment as soon as feasible to

allow for detailed cost estimate development.

- Decommission (clean to greenfield) each of the three facilities as soon as feasible.
- Consider decommissioning the Sturgis now. Use money earmarked for the upcoming dry-docking to conduct the hazards survey and for finding a shipyard to decommission it.

These recommendations were based on minimizing the following risks to the Army: increasing disposal costs for radioactive and hazardous material; developing trends towards more restrictive disposal regulations; and possibly, increasing public relations problems.

Since the facilities are safe as is, the COE will identify requirements for decommissioning in the normal POM process. However, the COE has already initiated the dry-docking and "all hazards" survey to quantify the actual decommissioning efforts and costs for the barge, Sturgis.

Limited Remediation Efforts

At Ft. Greely, a radioactive water line that carried waste from the reactor to a dilution well and then to a creek for further dilution traversed an area closing under BRAC. Radiation levels near the pipe were approximately ten times background so, under BRAC rules, funds were allocated to clean-up the pipeline and dilution well to an acceptable residual level. The BRAC committee, Alaska District of the COE, and their contractor, Jacobs Engineering, managed the remediation effort. The pipeline and surrounding soil have been removed and back filled, and the dilution well has been remediated. An appropriate radiological sampling scheme has been developed, and it demonstrates compliance with clean-up criteria. Remaining issues are: remediating contaminated soil found at the dilution well outfall; verifying acceptable levels of residual contamination; and disposing of the remediated soil now stored in a controlled area on Ft. Greely.

Summary

The ARO is the focal point for all facets of reactor management including licensing reactors for operation, decommissioning reactors and disposing of radioactive waste, and ensuring that Army reactors meet Reactor Program objectives. The ARO is committed to its challenges in safely and securely managing the Army Reactor Program and its legacy.

CALENDAR EVENTS

Army Reactor Council Operational Review

WSMR, NM and APG, MD

17-21 May 1999

WSMR Fast Burst Reactor Safety Analysis In-Process Review

June 1999

For additional information about
the Army Reactor Program,
contact the ARO at
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CHEMICAL AND BIOLOGICAL CONTAMINATION SURVIVABILITY

Mr. Stephen L. English

Process Manager for NBC Contamination Survivability in the Joint Service Materiel Group, SBCCOM

In recent months, there has been almost no limit to the amount of information we hear regarding the threats from weapons of mass destruction. The Department of Defense (DoD) Quadrennial Defense Review, dated May 1997, states "threat or use of chemical and biological weapons (CBW) is a likely condition of future warfare, including in the early stages of war, to disrupt U.S. operations and logistics." Therefore, "U.S. forces must be properly trained and equipped to operate effectively and decisively in the face of CBW attacks."

In this article, I will briefly discuss chemical and biological agents, explain CB survivability requirements, define what CB survivability is, and discuss the philosophy for its application. *I will not be addressing the "N" or nuclear aspects of NBC Contamination Survivability* (see Editor's Note below). I also hope to dispel fears that accomplishing CB survivability is in the "too-hard-to-do box" by giving some principles to follow that will help attain CB survivability goals. Finally, I will provide a "road map' with useful contacts.

Chemical and Biological Agents

Chemical agents are highly toxic chemical compounds found on the battlefield such as vapor, solids, liquid aerosol or slowly evaporating liquid droplets. They can include nerve, blister, blood, choking, and incapacitating agents. Nerve agents interfere with the nervous system and can cause death due to the individual's inability to control breathing muscles. Blister compounds destroy tissues, while blood and choking agents interfere with the transfer of oxygen to the blood.

Biological agents and toxins present themselves as aerosols and particulates. They are extremely potent in small quantities and include a wide spectrum of known diseases. Biological agents are not particularly destructive to materiel, but chemical agents and decontaminants can be. In liquid form, chemical agent droplets may penetrate coated and uncoated lenses or delicate electronic circuit boards and, for some transparencies and electrical contacts, that can spell disaster. Aerosols and liquids adhere to surfaces, spread over surfaces penetrating through small cracks and crevices, screw threads, rivets, joints and flanges. They also readily absorb into porous materiel such as rubbers, plastic, wood, paints, canvas, etc. Subsequent evaporation and desorption of these aerosols and liquids may cause significant hazards to unprotected personnel. For these reasons, it is critical to develop equipment with design features that minimize potentially lethal and damaging CB effects to personnel and equipment.

CB Survivability Requirements/ Definition

Scientists and engineers from Army, Navy, Air Force and Marine Corps research laboratories, development centers, and test and evaluation communities work as an integrated Joint-Service team to determine the vulnerability of systems to the CB threat and to develop and field CB defense equipment to counter that threat.

If equipment is "mission-critical" under the requirements of DoD Acquisition Regulation 5000.2, one of the challenges that all combat developers must address is ensuring that "mission-critical systems are survivable to the threat levels anticipated in their operating environment." CB contamination survivability is defined as the capability of a system and its crew to withstand a CB contaminated environment, including decontamination, without losing the ability to accomplish the assigned mission. All Services have implementing instructions and Service-specific regulations to guide the development of equipment and to provide guidance on CB contamination survivability. CB contamination survivability is desirable for all systems but directive for mission-critical systems.

In the Army's acquisition system, the materiel developer receives instruction from the "user or combat developer," by way of the Operational Requirements Document (ORD), on whether a particular system has to meet CB contamination survivability standards. If required, the system is issued specific CB contamination survivability criteria or, standards for use, in designing and testing of that equipment.

The characteristics of CB contamination survivability are compatibility, decontaminability, and hardness.

- Compatibility is defined as the ability of the system to be operated, main-

Editor's Note: The "N" or nuclear aspect of Nuclear, Biological and Chemical (NBC) Contamination Survivability refers to residual radiation effects on materiel. Residual radiation is composed of radioactive fallout contamination and neutron induced gamma activity (NIGA). Unlike chemical and biological contaminants which require removal with use of harsh decontamination agents, radioactive fallout contamination poses less of a concern since it can be easily removed by brushing off or washing down contaminants without damage to equipment. Likewise, NIGA presents less of a problem if reasonable attention is given to problem materials and/or material selection.

tained and resupplied by personnel wearing the full NBC protective ensemble (MOPP IV).

■ Decontaminability is defined as the ability of a system to be rapidly and effectively decontaminated to reduce the hazard to personnel operating, maintaining and resupplying it.

■ Hardness is defined as the ability of a system to withstand the materiel-damaging effects of CB contamination and any decontamination agents and procedures required to decontaminate it.

CB Survivability Application Philosophy

The philosophy that governs application of CB survivability is that "A soldier or crew surviving a CB attack should be able to continue his/her mission using mission-essential equipment in full NBC protective ensemble if necessary. Soldiers must be able to operate equipment and continue their mission while being protected from the agent's toxic effects. Furthermore, equipment must be able to be decontaminated to allow soldiers to operate it without the full protective ensemble." This philosophy is consistent with the needs of both user and materiel developer because it centers on the essential needs of the soldier and completing the mission successfully.

CB contamination survivability characteristics and criteria for hardness and compatibility are not difficult or expensive to meet. If CB contamination survivability measures are incorporated early in the development cycle, they account, on average, for only two percent of total costs; but if the system requires retrofit later, costs can escalate to about seven percent of system costs. Decontaminability continues to remain a technical challenge for most materiel developers because of the nature of existing field decontaminants.

CB Contamination Survivability Principles

CB system survivability goals can be met if the acquisition community applies the following principles during the management of the development program:

■ Review pertinent regulations governing CB survivability and ensure a complete understanding of the requirements, definitions, technical characteristics and limitations.

■ Ensure the ORD recognizes chemical and biological threats and that it defines critical survivability capabilities with measurable, quantitative parameters amenable to verification by testing and evaluation. (Read QSTAG 747, edition 2 and Allied Engineering Publication – 7, edition 3.)

■ Consider CB survivability early in the development process. Build it into the design rather than adding it on later or at a higher cost.

■ Ensure that Cost and Operational Effectiveness Analyses use measures of performance and effectiveness to evaluate chemical and biological survivability alternatives and to compare the cost effectiveness of alternatives to meet chemical and biological threats.

■ Base critical technical parameters and measurable operational issues in the Test and Evaluation Master Plan on the parameters defined in the ORD, and ensure they form the bases for adequate developmental and operational testing of chemical and biological survivability capabilities. Ensure required testing is planned, executed and evaluated before the system enters production.

■ Include specifications in system designs and contracts that are appropriate for meeting the chemical and biological survivability parameters defined by the ORD.

■ Make maximum use of materials that do not absorb CB contaminants and that facilitate the rapid and efficient removal with decontaminants readily available on the battlefield.

■ Incorporate designs that reduce or prevent accumulation of CB contamination and make exposed areas readily accessible for decontamination.

■ Employ devices and appropriate means, such as positive overpressure systems for combat vehicles, packaging for supplies and protective covers, and the application of protective coatings, to reduce contamination to be removed.

■ Establish logistics support plans that ensure systems can be maintained, as required, in CB environments.

■ Finally, seek assistance from technical experts and from published information, reports and databases.

These measures will help materiel developers achieve CB survivability and reduce hazards to soldiers operating equipment in a CB environment.

Road Map/Useful Contacts

Below is a simple "roadmap" for the CB community to follow:

■ The combat developer provides the CB requirement in the ORD.

■ The U.S. Army Nuclear and Chemical Agency provides the CB contamination survivability criteria to the materiel developer (for Army Programs only).

■ The Army Research Laboratory/ Survivability/Lethality Analysis Directorate, NBC Effects Branch, can assist in determining system vulnerability and methods to meet CB contamination survivability criteria.

■ Dugway Proving Ground, West Desert Test Center, Chemical Test Division, can assist with CB testing.

■ The Operational Test and Evaluation Command, Evaluation Analysis Center, can assist with interpreting the Systems Evaluation Plan requirements and structure test and evaluation programs.

Where can one go for assistance with CB survivability questions? The following are some useful sources:

■ U.S. Army Soldier Biological Chemical Command, ATTN: Stephen L. English, Process Manager for NBC Contamination Survivability in the Joint Service Materiel Group, DSN 584-3264 or (410) 436-3264.

■ U.S. Army Research Laboratory, Survivability/Lethality Analysis Directorate, NBC Effects Branch, DSN 584-2922 or (410) 436-2922.

■ U.S. Army Nuclear and Chemical Agency, Chemical Division, DSN 656-7871 or (703) 806-7871.

■ Headquarters, U.S. Army Training and Doctrine Command, Soldier Support and Chemical/Biological Division, DSN 680-4413 or (757) 727-4413.

■ U.S. Army Dugway Proving Ground, West Desert Test Center, Chemical Test Division, DSN 789-5137/38 or (435) 831-5137/38.

■ U.S. Army Operational Test and Evaluation Command, Evaluation Analysis Center, Survivability Division, DSN 458-0459/0461 or (410) 306-0459/0461.

■ Chemical and Biological Information and Analysis Center, (410) 676-9030.

Surety Update

MAJ Stacy A. Grams, MP
Nuclear Weapons Security Officer, USANCA

1998 Personnel Reliability Program (PRP) Status Report

USANCA thanks everyone who provided timely input to the annual PRP Status Report. The PRP population remained relatively unchanged from the 1997 report. The Army's nuclear and chemical surety programs include nearly 3,000 members. The total number of decertified personnel declined from 57 to 37 compared to last year's report. The reasons for decertifying personnel from the PRP included alcohol and drug abuse (9), negligence or delinquency in performance of duty (2), conviction or involvement in a serious incident (2), medical condition (19), serious progressive illness (1), poor attitude or lack of motivation (2), and failure to disclose PDI (2).

Over the past year, four additional nuclear surety programs were identified, one in the U.S. and three in Europe. There are currently over 170 individuals in the nuclear PRP. In addition to the two reactors, there are several Army units that support the Joint Staff by storing sealed authenticators used in the nuclear weapons release process.

The annual PRP Status Report is required by DoD to capture the total picture of the PRP. Thus, it is critical that all Army organizations with either a nuclear or chemical surety mission accurately report their PRP information. (POC: MAJ Grams, DSN 656-7859, com (703) 806-7859)

Rewrite of Army Nuclear and Chemical Surety Regulations

USANCA continues to update AR 50-5, Nuclear Surety, and AR 50-6, Chemical Surety. Both documents are nearing completion and should be ready for final Army staffing shortly. The primary stumbling block has been an ongoing effort by the Department of Defense (DoD) to update DoD Directive 5210.42, Nuclear Weapons Personnel Reliability Program (PRP). This directive is the principal source of guidance for all aspects of Service PRPs, including those associated with chemical agent activities and nuclear reactor operations. Thus, changes to this document directly impact how the Army rewrites AR 50-5 and AR 50-6. Some of the changes being considered by DoD include:

- Incorporates authorization for National Guard/Reserve personnel who participate in active duty periods for training or other temporary service (must be beyond just weekend duties) to be certified into the PRP.

- Adds suicide attempts as a disqualifying factor for the PRP.

- Eliminates the "grandfather" clause under which certifying officials could retain in the PRP individuals who had disclosed pre-Service drug abuse but who had been certified into the PRP under the more flexible rules that existed pre-1995.

- Adds a requirement that before a certifying official can reconsider an alcohol abuser for requalification into the PRP, the certifying official must document his/her trust in the individual's reliability and that the individual's continued presence in the PRP outweighs the risk from potential future alcohol-related incidents.

If you have any comments/concerns regarding the proposed DoD changes noted above, please let us know ASAP. (POC: MAJ Grams, DSN 656-7859, com (703) 806-7859)

US Army Personnel Reliability Program Status Report - 1998

PRP Personnel	Nuclear (Critical/Controlled)		Nuclear Reactor (Controlled)	Chemical (Controlled)
DoD Military	51	0	56	321
DoD Civilian	4	0	60	1413
DoD Contractor	0	0	0	1024
Total	**55**	**0**	**116**	**2758**
Decertified Personnel				
DoD Military	0	0	0	7
DoD Civilian	0	0	0	21
DoD Contractor	0	0	0	9
Total	**0**	**0**	**0**	**37**

SURETY QUESTIONS AND ANSWERS

Q Please clarify some issues about personnel security investigations. How often must a person in the chemical PRP have a personnel security investigation/ periodic reinvestigation (PSI/PR)? Is there a difference in time requirements for military and civilian/ contractors? Are there any special requirements for PRP members who require a clearance? The numerous messages and changes have only confused me more.

A Rather than try to explain the details in words, we have prepared the accompanying matrix that details the current chemical surety PSI requirements. The PSI must be a favorably completed National Agency Check (NAC), National Agency Check Plus Written Inquiries (NACI) or higher PSI. (MAJ Grams)

Q Does the individual assigned as the certifying official have to be indoctrinated into the PRP (been briefed by the reviewing official in Part V of DA Form 3180) prior to being able to give the initial interview?

A Yes. However, an individual who is acting as a certifying official only for the purpose of administrative screening need not be in the PRP (para 3-12c, AR 50-5 and para 2-12b, AR 50-6). (MAJ Ward)

Q Does the certifying official need to be on written orders identifying him/her as such? Does the reviewing official need to be on orders?

A AR 50-5 and AR 50-6 do not require a certifying official be on written orders, nor do they require the reviewing official be on orders. However, the certifying official must be listed on the nuclear/ chemical duty position roster in either a critical or controlled position (note all chemical PRP positions are equivalent to nuclear controlled positions), commensurate with the highest category of PRP duty position in the unit. The reviewing official certifies and appoints the certifying official. To provide a practical break in this certification chain, the reviewing official does not have to be in the PRP, unless he/she is required by AR 50-5/50-6 to be in the PRP for other reasons. (MAJ Ward)

Q Why aren't PRP positions being properly annotated on unit MTOEs?

A There is no requirement for a TDA or MTOE to indicate that a specific position falls under the PRP. To help ensure that individuals arriving to fill PRP designated positions are in fact PRP qualifiable, your unit should include in personnel requisitions a statement that the position requires an individual qualified for assignment to a (critical or controlled) nuclear/ chemical duty position per AR 50-5 or AR 50-6. The sending unit/ activity is responsible for conducting the administrative (levy) screening (paras 3-9a(2) and 3-12, AR 50-5 and para 2-9a(2) and 2-12, AR 50-6) prior to letting the individual depart for the PRP assignment. We recommend that you communicate directly with the unit/ activity providing the soldier to ensure that this requirement is fulfilled. (MAJ Ward)

PSI Time Requirements for PRP

Type of Assignment	5 Years or Less	More Than 5 Years
Initial Assignment	Investigation Valid	New Investigation Required
Consecutive PRP Assignments or Assigned to a PRP Position Within Last 5 Years	Investigation Valid	Military: Investigation Valid Civilian/Contractor: New Investigation Required
Assigned to PRP Position More than 5 Years Ago	Investigation Valid	New Investigation Required
Break in Active Duty Military Service or DoD Employment of More Than 2 Years	New Investigation Required	New Investigation Required

Dear Editor

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